The Far Eastern Review

Reconstruction Number

June-July, 1925

A Monument To The Japanese Engineer

The Reconstruction of

Tokio

and

Yokohama

Part 2 of a digital scan of the combined June & June,1925 edition (Volume XXI) of The Far Eastern Review. This part comprises pages 395- 524, advertising pages *81-122* & the magazine's rear cover

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Note: The June -July 1925 edition of The Far Eastern Review was a special combined two-month bumper "Reconstruction Number" dedicated to the work of Japanese engineers who had rebuilt devastated industrial plants and infrastructure of "Tokio" (Tokyo) and Yokohama following the 'Great Kanto Earthquake' of 1923.

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An Engineering Triumph

Restoration of the State Railways in Record Time

I. Extent of Damages due to the Earthquake.

(1) Mileage of damaged tracks	418 miles
(2) Length of damaged embankments ..	45 „
(3) Land slide of cuttings	33,000 cubic *tsubo*
(4) Falling of stone works on the cuttings	2,500 *tsubo*
(5) Number of damages on bridges and arch bridges	223
of which, number of falling girders ..	12
Total length of damages ..	7,250 feet
(6) Total length of damaged or collapsed tunnels	1,000 „
(7) Number of stations damaged to considerable extent	75

II. Progress of the Restoration Works.

Although there were great number of those serving in the maintenance of way who had been sufferers themselves from the earthquake, their families receiving injuries to more or less extent and their houses and properties burning in the fire following the quake, they had no time to look for their own private affairs, and they went out without delay on the call of their duties. With the aid of those working in neighborhood and of other railway employees, they fought sternly to put out the fire and save the lives, doing their best to communicate the news to proper authorities despite the fact that all means of communication have ceased, and provide emergency measures for the restoration of traffic. Those in regional offices and other men in executive staff had without delay formed an emergency relief organization, giving orders to general employees and asking speedy aid to various quarters, and decided for the execution of the emergency measures. Maintenance of way staff from the neighboring districts also came out to aid on immediate notice. All these men concentrated their utmost efforts continuously for days and nights to the end that works of restoration should be speedily carried on. As the result of the efforts traffics were re-opened as follows:

(1) *The Tokaido Line (principal trunk line).*—After the disastrous quake, a small section of the line was re-opened for traffic in 3 days and that portion extending from Tokyo to Yokohama was restored in 5 days.

Re-opening was done section by section until a connection over the Hakone pass (about 1 mile) was effected by foot on September 17 and the connection over the Banyu River by ferries on the following day, thus making complete connection over the whole of the Tokaido line. The emergency works having been subsequently completed, connection by foot was abandoned on December 14, thus restoring the usual through train service.

(2) The Yokosuka Line.—The emergency work was started on September 5 and the section between Ofuna and Kamakura was opened on September 7, the through train service on this line having been resumed on September 30.

(3) The Atami Line.—Considerable damages had been brought on the line. The emergency work was started on September 12 and a portion of the line re-opened on October 15, the through service of the trains having been resumed on October 1 this year.

(4) *The Chuo and Yamate Lines (suburban lines of the city of Tokyo).*—The whole of these lines except a small section was restored and opened for traffic in 3 days after the quake.

(5) *The Sobu and Hojo Lines.*—The emergency work on these lines was started on the very day of the disaster; those sections receiving only slight damages were opened a few days after and the whole lines re-opened for traffic on November 20.

(6) *The Tohoku, Joban and Yokohama Lines and their branches.*—These received comparatively slight damage, so that within from 2 to 10 days after the emergency work was started they were opened section by section until the through service of trains was resumed at the end of September last year.

In executing emergency works mentioned above, efforts were concentrated on the principal trunk lines, urgency of the work having been determined by the extent of the damage and the condition of the tracks; and the work has been carried on step by step. These emergency works had been done in the main on the exact position where previous rails were, or an entirely new spot was selected for re-laying of rails.

In cases of bridges, the same steel girders as had been used prior to the quake were again used; those girders found unfit for use were replaced with those brought from other lines in course of construction, with piers and abutments made of wood.

For cracks of tunnels centres were constructed with bend rails to support the cracked portions.

At the fallen embankments, grade was temporarily changed, for instance from 1/100 to 1/80.

Thus emergency works have been executed to the extent to have the trains operated without hindrance.

The permanent restoration works aiming to re-model on permanent basis what had been accomplished by the emergency works mentioned above are to be done on a general plan existing before the quake; there have been found, however, some 40 sections where changing of track location has been considered advantageous.

The program of permanent restoration works are to be carried on completion till the fiscal year of 1926. These works so far accomplished reach to about one third (about Y.12,000,000 has been spent for the purpose).

Restoration Expenses and Financial Condition of the State Railways

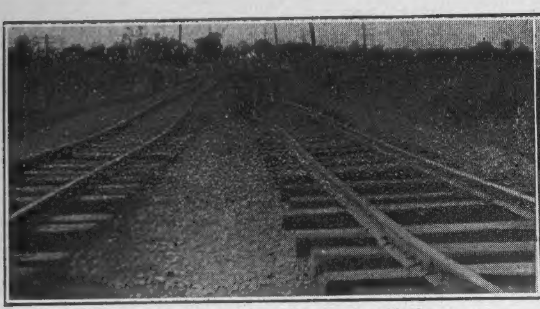
The great earthquake and fire of 1923 caused damage to the railway tracks and buildings, amounting to about Y.28,800,000. In addition to this, loss estimated on the burnt materials for railway operation was considerable, making the total loss some Y.34,500,000. The sum refers only to the value of properties lost as shown in accounting books. There is still further loss encountered in connection with railway operation. The emergency works on the permanent way and structures destroyed, and the reinforcement works on the various structures that have been saved from collapse have also been required. For these purposes a sum of Y.19,320,000 had to be paid out from the Revenue Account in 1923. Thus various providences have been reinstalled to the extent that passenger and freight traffic could be carried on without much difficulties, and at present the train operation has practically resumed its normality.

Although it had been anticipated that all restoration works could be completed within four years—from the fiscal year 1923 to 1926—with the expenditure of about Y.50,000,000, the budget to cover the works has been arranged, after taking into consideration the fact that in view of the quake more security should be obtained in the works and that the design hitherto prevailed on various equipments would be altered as the reconstruction of the Capital progresses. The budget is for continuous works extending over six years from 1923 to 1928. Although a supplementary budget was drawn subsequently for reconstruction expenses this failed to receive the legislative sanction owing to the dissolution of the Imperial Diet last year. The works, however, have been carried on as planned, the expenses having been met with the money provided for improvement works which have been temporarily postponed.

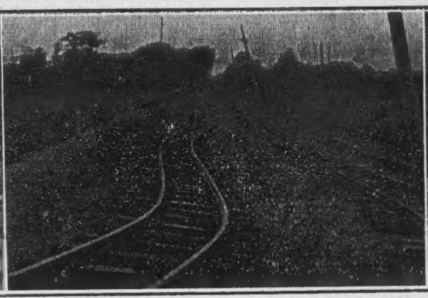
Following gives the detail of the budget.

Year	Restoration budget	Reconstruction budget	Total
	Yen	Yen	Yen
1923	5,000,000	—	5,000,000
1924	21,162,000	13,838,000	35,000,000
1925	14,031,000	10,969,000	25,000,000
1926	9,686,000	10,314,000	20,000,000
1927	—	20,000,000	20,000,000
1928	—	20,000,000	20,000,000
Total	49,879,000	75,121,000	125,000,000

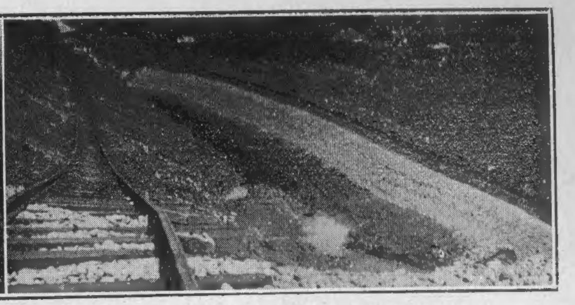
As to the financial condition of the Government Railways, the estimated Revenue Account for the fiscal year 1923 shows a revenue of Y.448,266,091; the expenditures Y.328,479,055 in connection with operation, leaving a net surplus of Y.119,919,036.



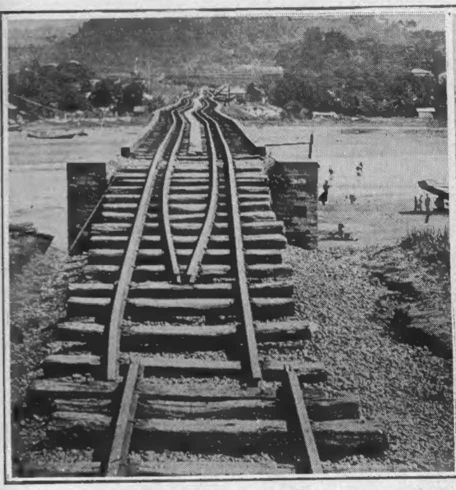
Falling of track and bending of rails between Chigasaki and Hiratsuka, Tokaido Line



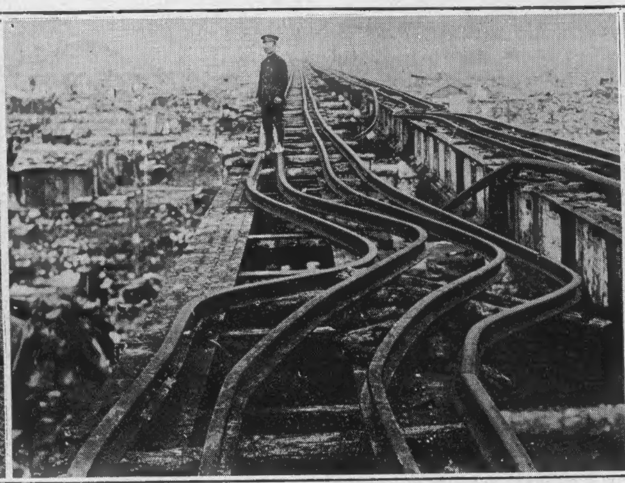
Sinking of track and bending of rails between Tsujido and Chigasaki, Tokaido Line



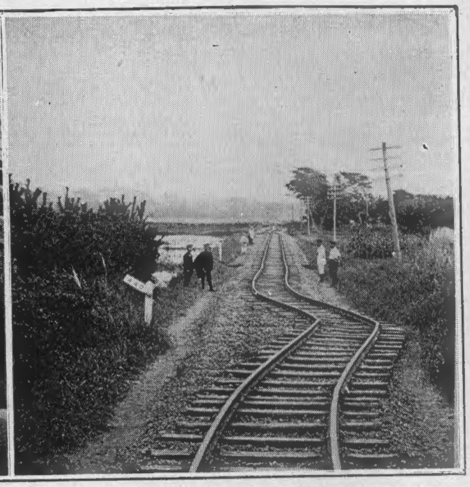
Shifting of road bed, leaving the track in its original position, between Nebukawa and Manazuru, Atami Line



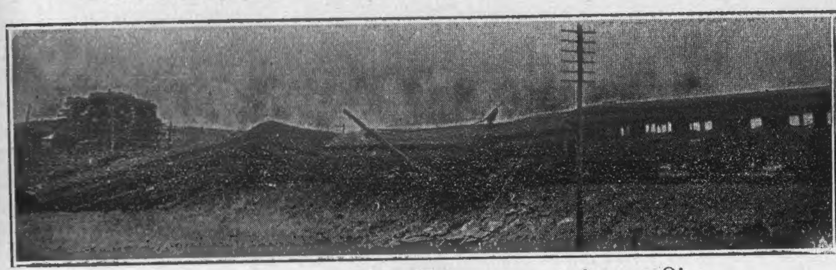
Bending of rails on the bridge over Minato River and sinking of embankment between Kazusa-Minato and Hama-Kanaya, Boso Line



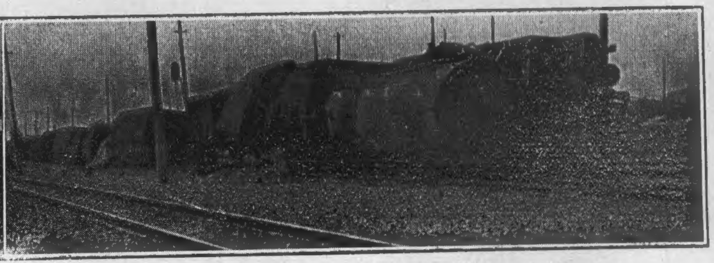
Bending of rails on elevated line between Ryogokubashi and Kinshicho, Tokyo, after the earthquake and fire



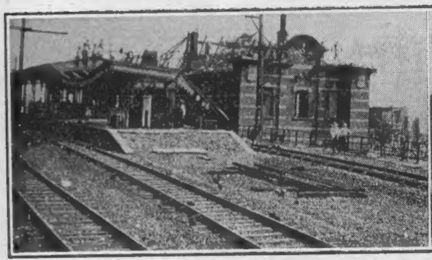
Bending of track between Nakotunagata and Awahojo, Boso Line



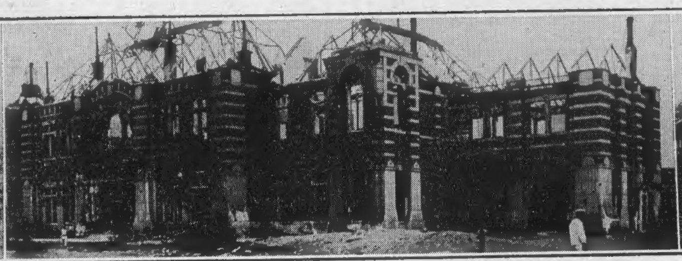
Derailing and overturning of a passenger train near Oiso Station, Tokaido Line



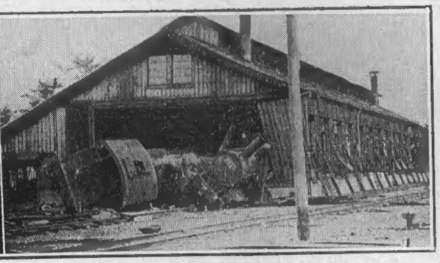
Overturning of a freight train in the Chigasaki Station Yard, Tokaido Line



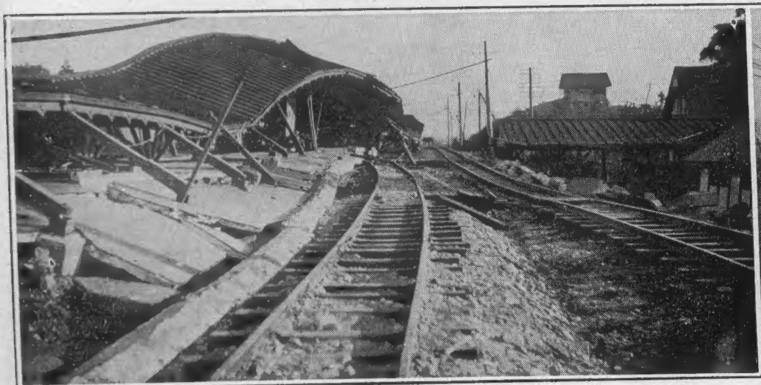
Manseibashi Station, Tokyo, as it looked after the quake and fire



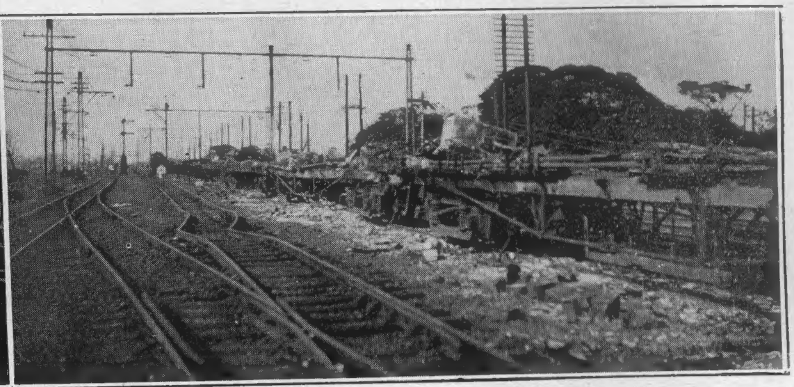
Shimbashi Station, Tokyo, after the earthquake and fire have worked their way



Overturning of locomotives in engine shed and in the yard, Awahojo Station, Sobu Line



Cracking and sinking of platform and collapsing of its shed, Odawara Station, Atami Line



Skeleton of a burnt train in Hamamatsucho Station, Tokyo

As to the Capital Account, the profit to be transferred from the Revenue Account, Y.70,000,000 to be raised by a public loan, the miscellaneous receipt of Y.2,000,000 and the fund of Y.9,000,000 to be brought over from the preceding year were to be appropriated as the construction and improvement expenses. The revenues, however, as shown in the Revenue Account has fallen short of estimated owing to the unexpectedly big outlay (Y.19,320,000), temporary interruption of train operations on some lines in the devastated areas and transportation without charges or at reduced rates of freights and passengers. Consequently the profit has been reduced considerably.

The Government, as an emergency measure, has decided to suspend temporarily all the enterprises except those of urgent nature, the railway administration accordingly has had to alter so far as the Railway Capital Account is concerned, the schemes of construction and improvement works, some of which entirely suspended.

The brief statement of the budget on the Revenue and Capital Accounts for the fiscal year 1923 is as follows :

REVENUE ACCOUNT
(*Decrease)

Item	Original Annual Estimates	Settled	Increase on or Decrease from Estimates
	Yen	Yen	Yen
Receipt :—			
Traffic	442,294,195	436,466,521	*5,827,674
Miscellaneous	5,971,896	6,888,260	916,364
Total	448,266,091	443,354,781	*4,911,310
Expenses :—			
Operation	243,823,055	267,982,169	24,159,114
Interests and charges on loans	62,524,000	62,857,737	333,737
Subsidies to private local railways	2,000,000	2,218,875	218,875
Reserve	20,000,000	—	*20,000,000
Balance after deducting tentative receipts and advances paid in from overcharges refunded and advances ...	—	31,905	31,905
Total	328,347,055	333,090,686	4,743,631
Surplus (profit)	119,919,036	20,264,095	*9,654,941

CAPITAL ACCOUNT
(*Decrease)

Item	Original Annual Estimates	Settled	Increase on or Decrease from Estimates
Revenue :—	Yen	Yen	Yen
Net profit transferred	119,919,036	110,264,095	*9,654,941
Loans	70,000,000	39,690,000	*30,310,000
Miscellaneous	2,000,000	1,547,882	*452,118
Debentures	—	25,000,000	25,000,000
Brought over from the preceding year	9,000,000	9,000,000	—
Total	200,919,036	185,501,977	*15,417,059

Item	Estimates				Settled	Balance
	Original Estimates	Brought over from the preceding year	Reduction due to postponement of works	Estimates after deducting the previous item		
Expenses :—	Yen	Yen	Yen	Yen	Yen	Yen
Construction	70,000,000	1,744,378	6,759,000	64,985,378	64,496,320	489,058
Improvement	130,908,200	4,721,086	13,215,000	122,414,286	121,013,097	1,401,189
Redemption of national loans	10,836	—	—	10,836	10,835	1
Total	200,919,036	6,465,464	19,974,000	187,410,500	185,520,252	1,890,248

The settled revenues and expenses on the Revenue Account for the fiscal year 1923 ending March 31, 1925 cannot be definitely given as it is still unable to secure the operating result owing to the fact that it has come only to half the fiscal year. However, we can give the following figures as taking from the statement of the budget.

Revenue	Traffic	Y.487,380,942
	Miscellaneous	6,079,056
	Total	Y.493,459,998
Expenses	Working	Y.274,004,330
	Interest & charges on loans...	65,504,668
	Subsidies to private local railways	3,000,000
	Reserve	20,000,000
	Total	Y.362,508,998
Surplus (profit)		Y.130,951,000

With regard to the Capital Account for the fiscal year 1924, as the budget that has not been approved in the last session of Diet, it has been decided to follow the basis of the proposed budget. The reconstruction works, however, are being carried on as planned inasmuch as the supplementary reconstruction budget has been approved in the last session of Diet. This budget is as follows :

Construction Expenses	Y. 57,750,000
Improvement Expenses	138,547,000
For Improvement works	103,547,000
For Reconstruction works	35,000,000

The financial sources for the above comprise net profit, loans, fund brought over from the preceding year and the miscellaneous revenues belonging to the Capital Account.

Railway Operating Result During the Year 1924

As regard to the latest result of the year 1924, there are not definite figures obtainable, but the rough figures from January to December obtained from the number of passengers and tonnage of freights and the revenue from passengers and freights in each month may be compared with those of the corresponding months of the last year. The following table gives such result, showing an increase every month compared with the corresponding periods of the previous year. (Considerable increase in September is due to the great earthquake encountered the same month of last year which caused great interruption of traffic and consequent decrease of revenue.)

TRAFFIC STATISTICS for the Year 1924.
(I)

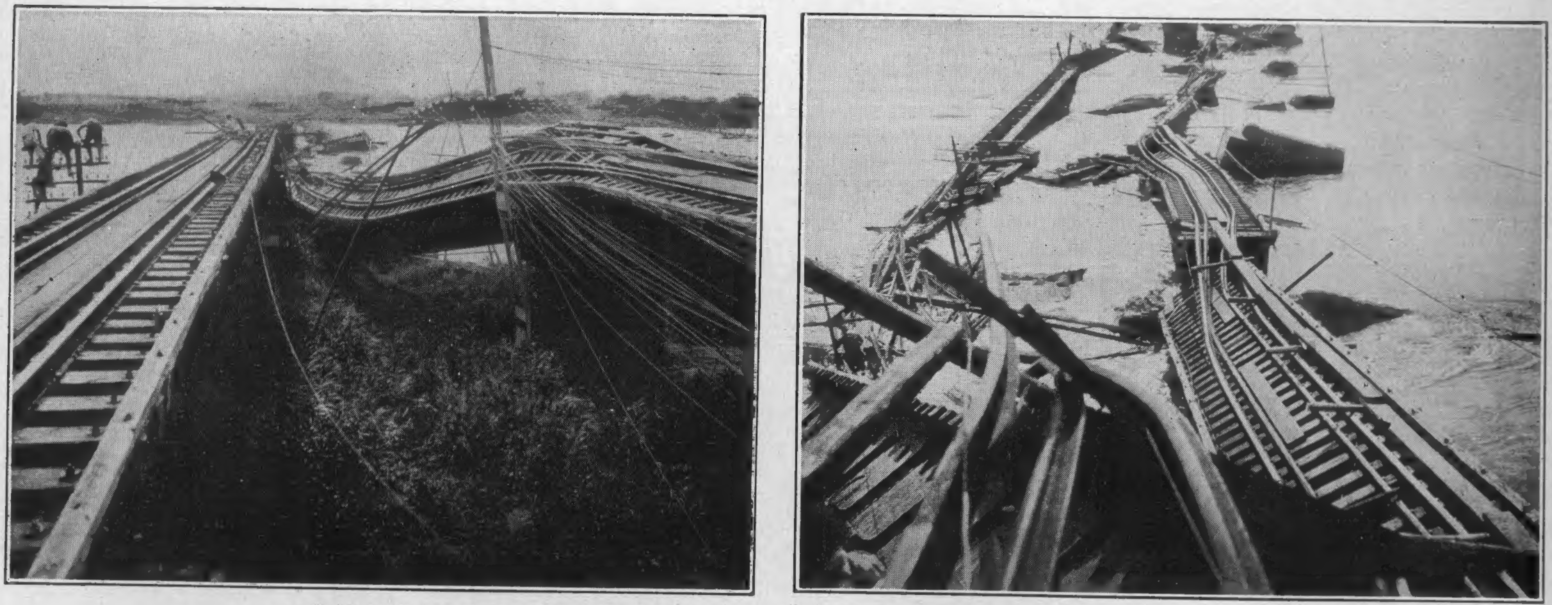
Month	Miles Open		No. of Passenger Journeys		Freight Traffic (tons)	
	1924	Inc. over 1923	1924	Inc. or Dec.	1924	Inc. or Dec.
January ..	7,247	262	48,738,519	10,530,291	4,959,257	463,535
February ..	7,251	264	41,576,254	9,418,593	4,961,957	382,389
March	7,277	282	46,466,960	5,073,502	5,789,708	375,637
April	7,348	310	104,671,608	13,205,206	5,643,441	451,607
May	7,366	310	54,145,047	8,756,455	5,658,453	255,780
June	7,370	303	42,843,218	6,649,565	5,219,378	181,318
July	7,387	312	44,833,150	5,166,265	5,081,879	347,607
August ..	7,415	332	46,121,179	4,331,441	4,751,517	*45,863
September ..	7,416	296	51,209,636	20,283,252	5,155,631	1,386,284
October ..	7,430	283	52,744,708	1,888,481	5,508,038	767,290
November ..	7,484	298	44,283,784	*588,168	5,343,292	592,806
December ..	7,517	290	42,445,391	*127,895	5,645,095	389,699
Total			620,079,454	84,586,988	63,717,646	5,548,089

TRAFFIC RECEIPTS for the Year 1924.
(II)

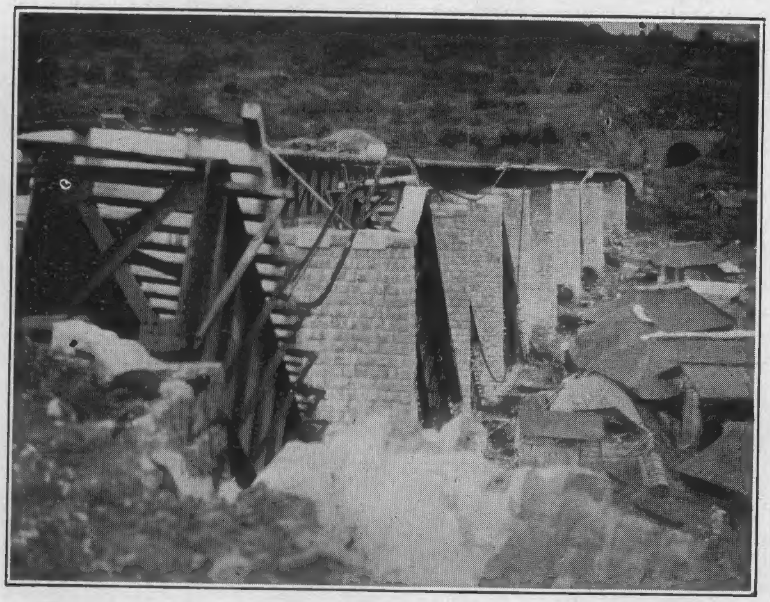
Month	Passenger Traffic Receipts		Freight Traffic Receipts		Total		Receipts per mile per day
	1924	Inc. or Dec.	1924	Inc. or Dec.	1924	Inc. or Dec.	
	Yen	Yen	Yen	Yen	Yen	Yen	Yen
Jan.	20,839,628	3,621,358	14,547,777	1,600,495	35,387,405	5,221,853	158
Feb.	18,817,096	3,315,548	14,941,749	1,534,204	33,758,845	4,849,752	161
Mar.	23,441,856	2,125,860	17,341,987	1,145,272	40,783,843	3,271,132	181
Apr.	28,788,448	1,914,227	16,851,898	1,321,269	45,640,346	3,235,496	207
May	24,164,820	2,013,578	16,663,741	701,516	40,828,561	2,715,094	179
June	19,166,787	1,831,502	15,486,281	582,928	34,653,068	2,414,430	157
July	20,221,241	1,013,775	14,822,364	853,028	35,043 605	1,866,803	153
Aug.	23,681,666	1,057,009	14,369,167	93,903	38,050,833	1,150,912	166
Sept.	20,029,845	3,868,438	15,889,758	5,992,956	35,919,603	9,861,394	161
Oct.	23,113,306	809,937	17,039,308	4,042,344	40,152,614	4,852,281	174
Nov.	20,129,528	*290,818	16,420,314	2,514,605	36,549,842	2,223,787	163
Dec.	19,716,284	*1,119,433	17,226,909	959,491	36,943,193	*159,942	164
Total	262,110,505	21,280,414	191,601,253	21,342,011	453,711,758	45,502,992	

Rates and Charges of the State Railways

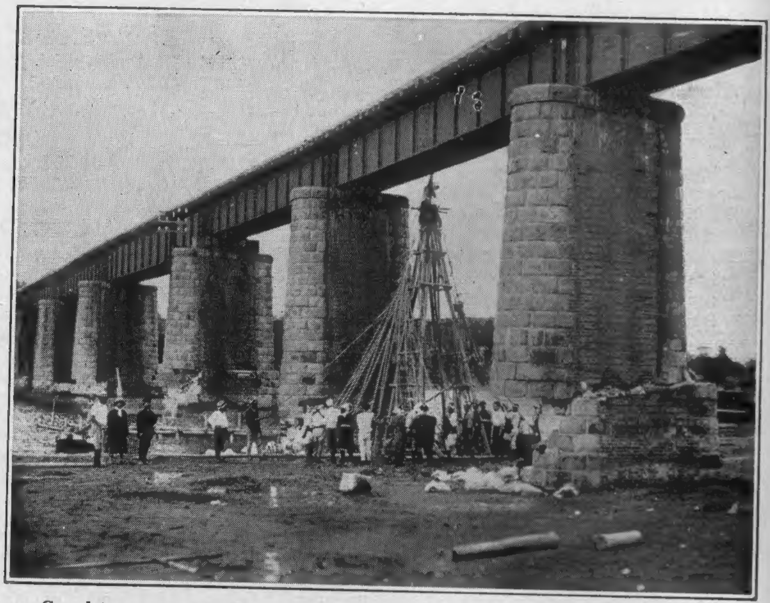
Rates on the State Railways of Japan have had to be advanced on the rates uniformly fixed since the nationalization of the railways, owing to the considerable rise of commodity price and wages and also operating expenses accompanying the abrupt booming in the economic world as a result of the great war. Twenty per cent. advance in passenger fares in July, 1918 and twenty per cent. advance in freight rates in October of the same year were made so as to keep the balance of revenues and expenditures. The rise of commodity price has still continued ; nevertheless, in view of the fact that further advance in railway rates would only help to make the price still higher, further advance in rates has been considered unwise. On the other hand there was an urgent need for better equipment of railway facilities and improvement, at the same time general rise of the cost of materials. Financial resources in consequence suffered greatly ; and even stringent economies effected in operation expenses finally became futile, unless some positive measure such as increase in revenue is considered. This led to further advance of railway rates—25 per cent. in passenger fares in February, 1920 and 28 per cent. in freight rates in January the



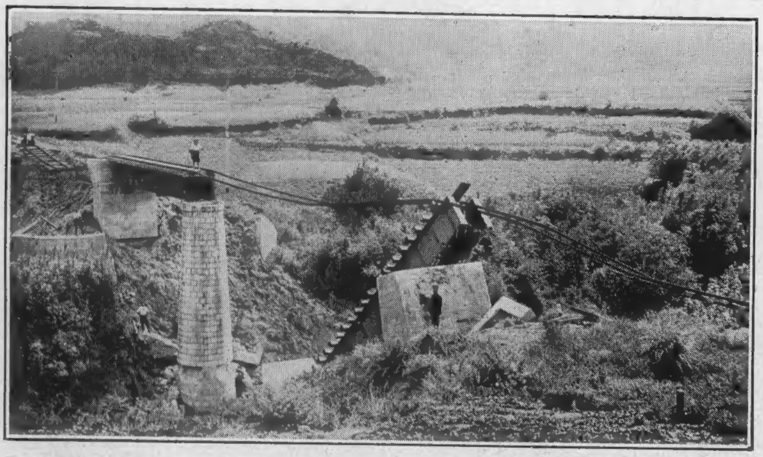
Collapse of the Banyu River Bridge, between Chigasaki and Hiratsuka, on the Tokaido Line



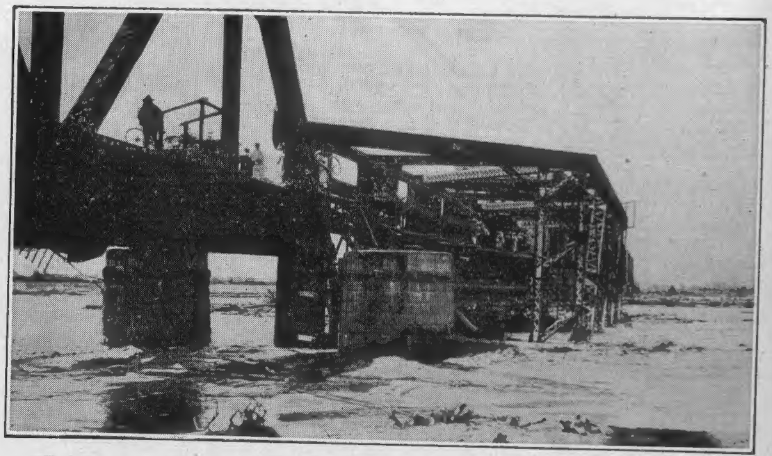
Falling of girders of bridge, between Hayakawa and Nebukawa, Atami Line



Cracking and shifting of Piers of the Minato River Bridge and an Emergency Repair Gang between Kazusa-Minato and Hama-Kanaya, Boso Line



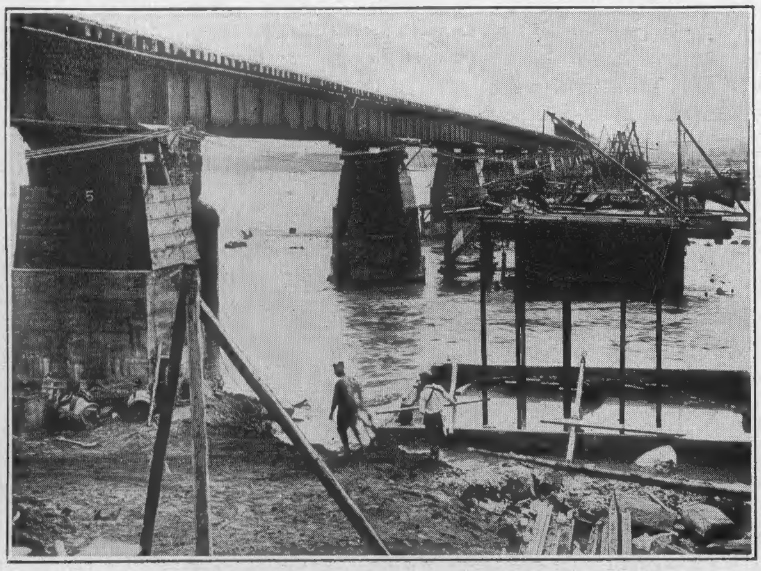
Falling of first Setogaya Bridge, between Kokonoe and Chikura, Sobu Line

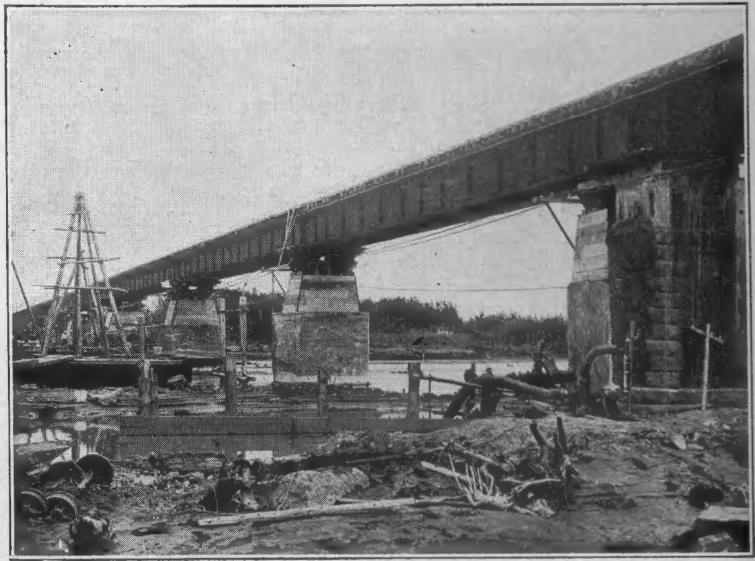


Falling of Sakawa River Bridge, between Kamomiyama and Odawara, Atami Line

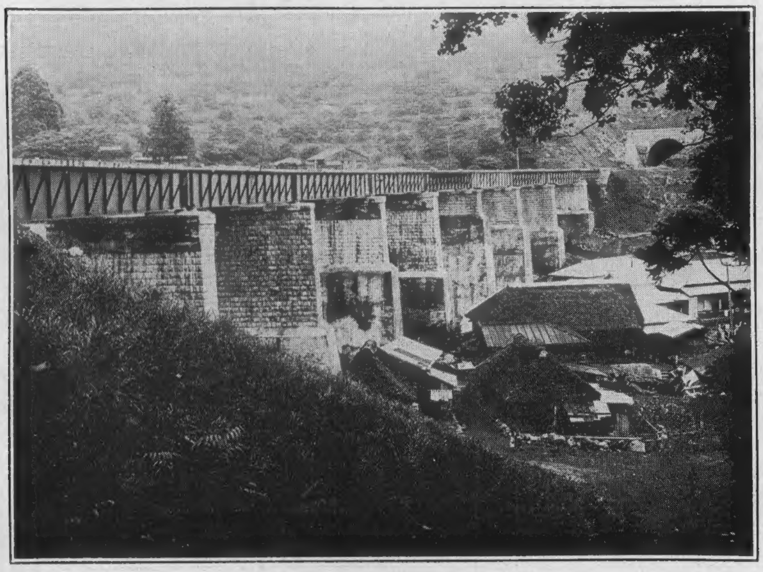
following year were put in force, revising at the same time the classification of freights in order to secure more equitable rates on various commodities. The following gives a comparison of the new rates and those of the past.

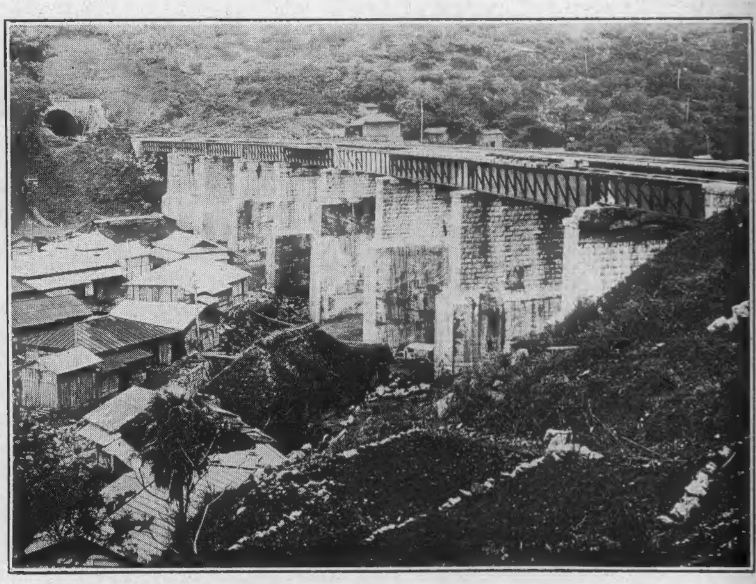
(a) *Passenger Fares.*—Passenger fares now in force were revised in February, 1920; charges are made according to the principle of "differential system," that is diminishing by steps as the distance increases; classes comprise first, second and third, first class cars are attached only to the principal trains on the main lines, on the rest of the lines these are not run, so that on the majority of lines and largest number of trains only two classes of cars, second and third, are attached.



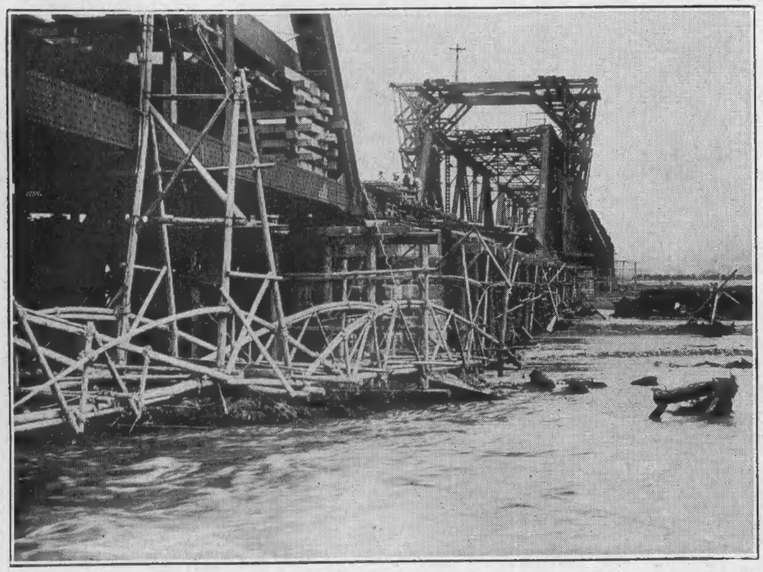


The Repaired Banyu River Bridge

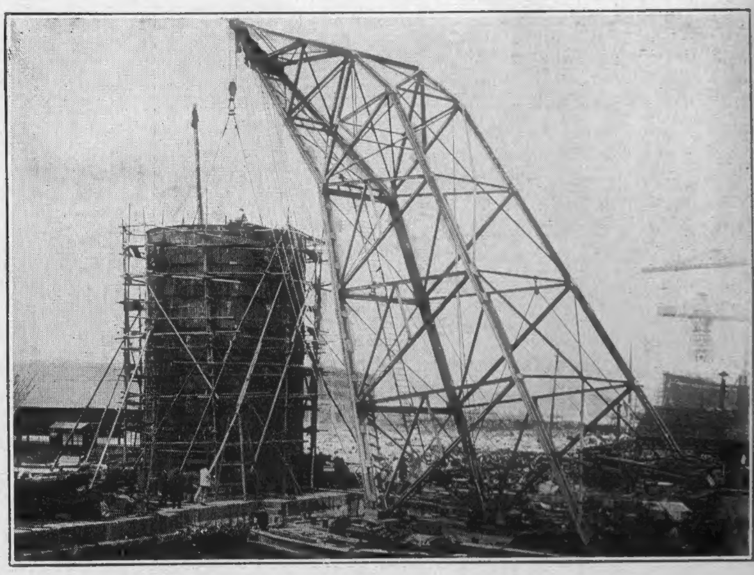




The Repaired Tamagawa Bridge



The Sakawa Bridge undergoing repairs: Second Span as shown on preceding page fell into water. Beams were raised by "Goliath" crane and used in new span



Erecting Caissons at Yokohama Dockyard for repairing Bridge Piers

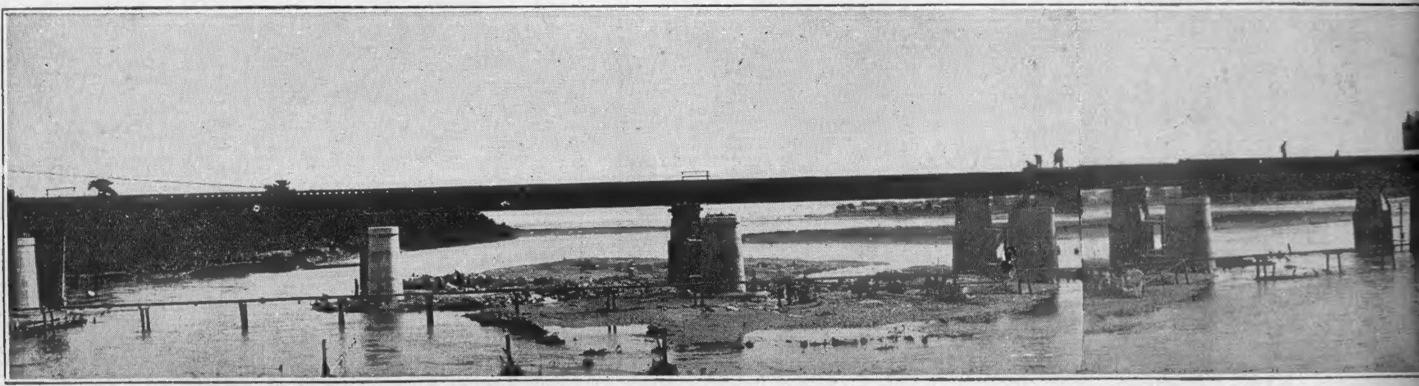


Fig. 1

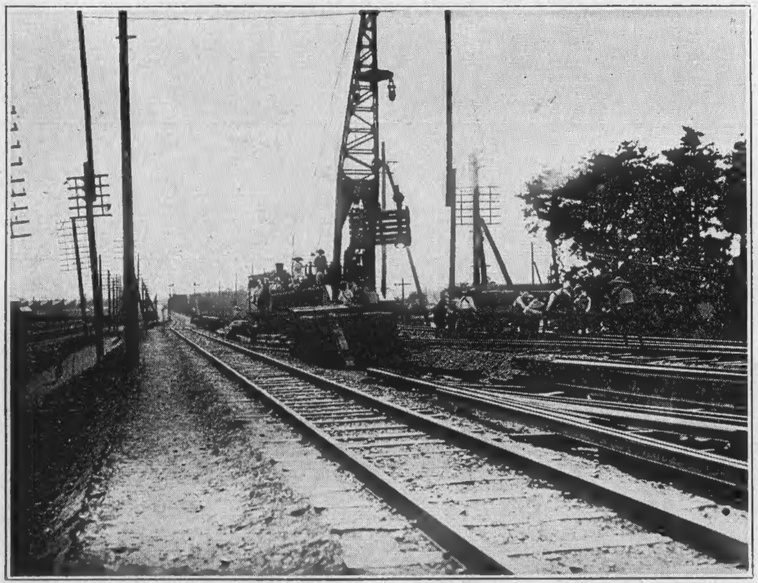


Fig. 2

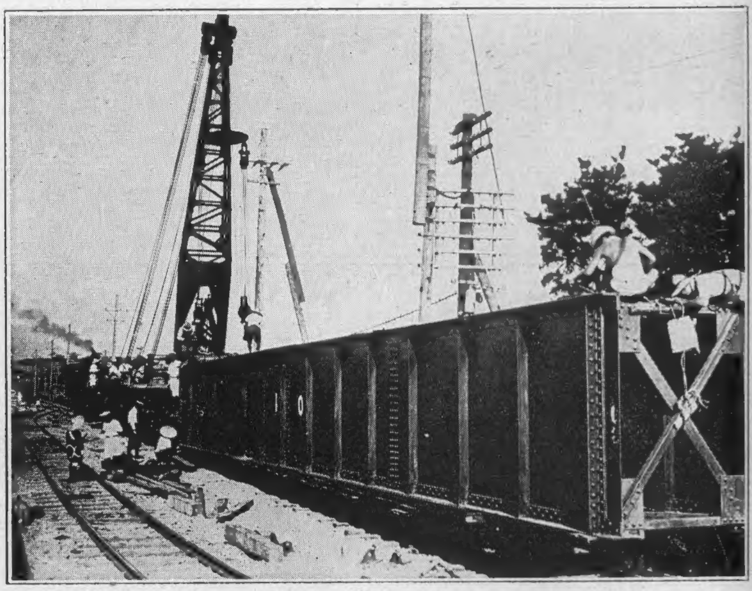


Fig. 3

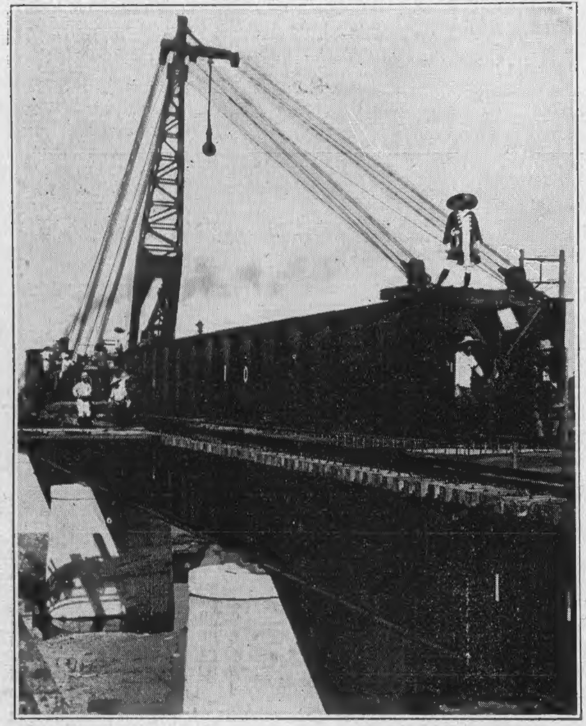


Fig. 4

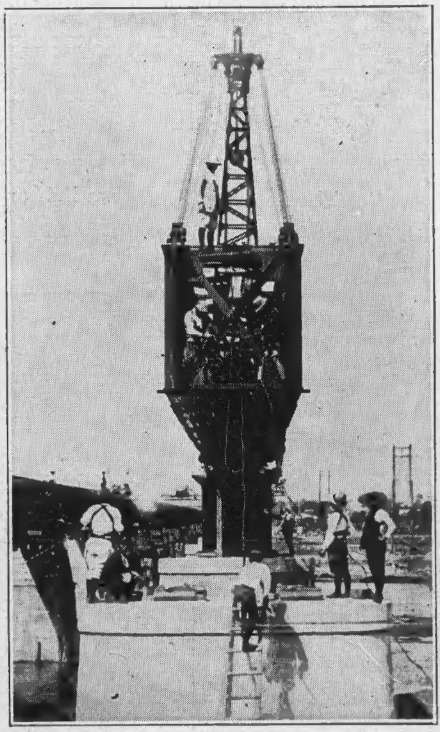


Fig. 5

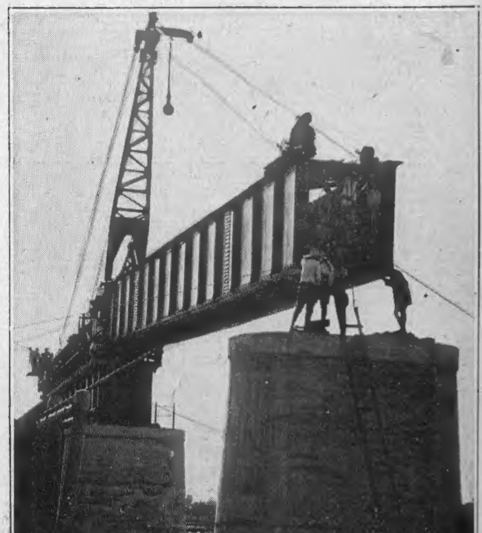


Fig. 6

RECONSTRUCTION OF THE BANYU RIVER BRIDGE NEAR YOKOHAMA

Showing the Various Stages of the Work as shown in Figures 1 to 10, carried through successfully by the Engineers of the Imperial Government Railways

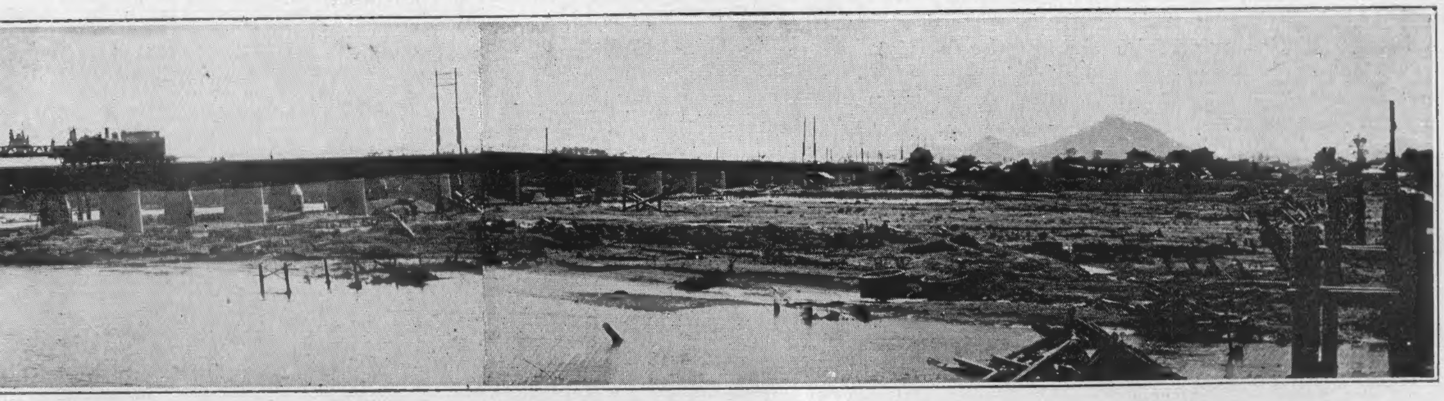


Fig. 1

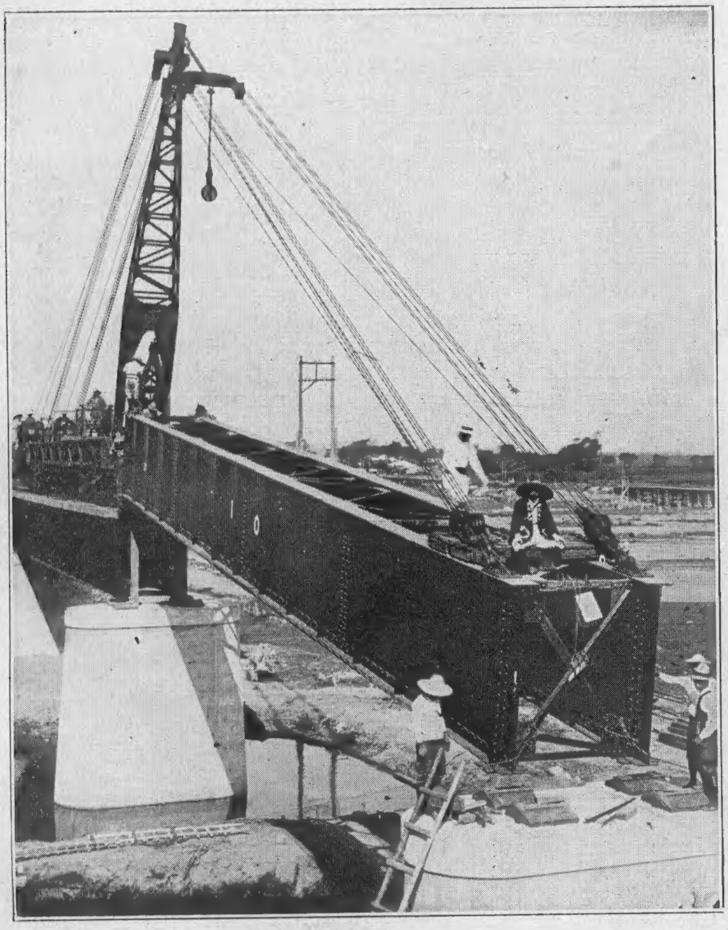


Fig. 7

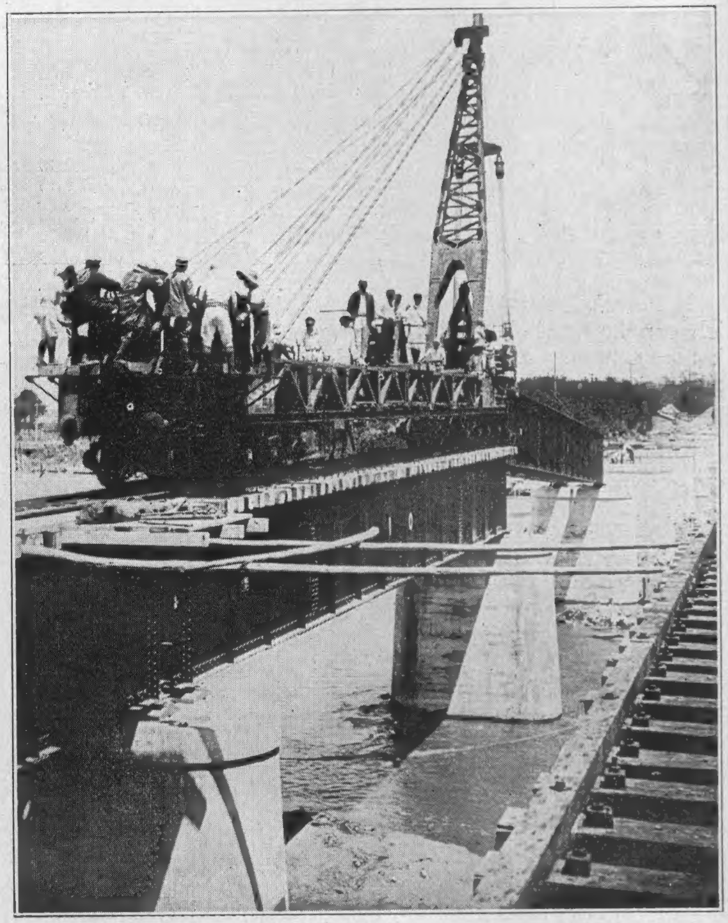


Fig. 8

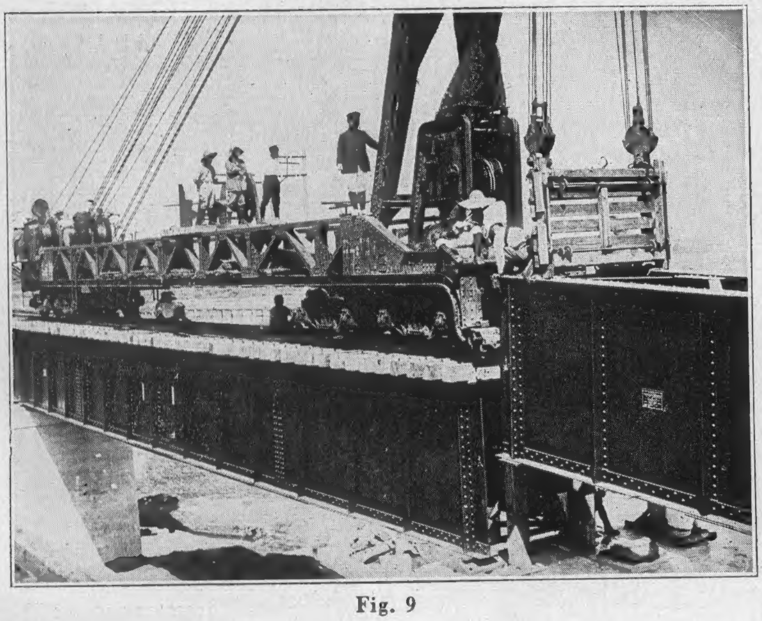


Fig. 9

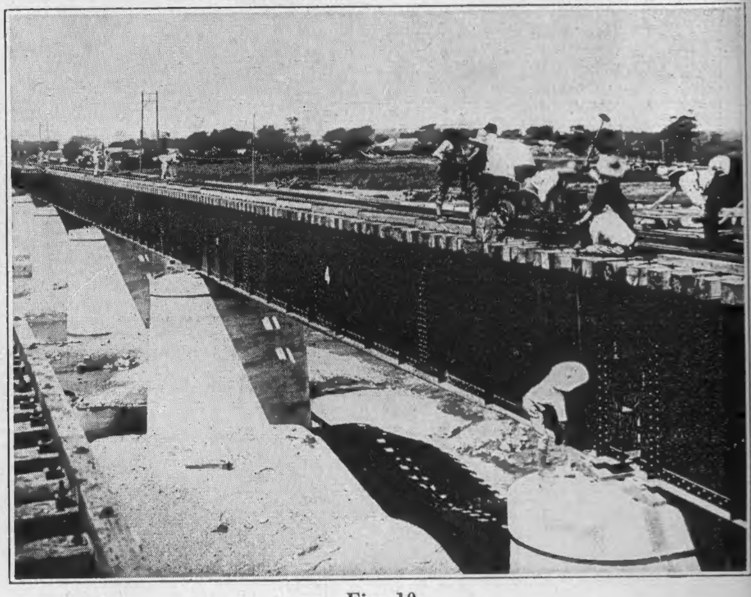


Fig. 10

THIRD CLASS PASSENGER FARES PER MILE.

Present (revised in February) 1920	Yen	Old (revised in July) 1918	Yen	Old (prior to July) 1918	Yen
up to 50 m.	0.025	up to 50 m.	0.020	up to 50 m.	0.0165
,, 100 m.	0.021	,, 100 m.	0.016	,, 100 m.	0.013
,, 200 m.	0.017	,, 200 m.	1.013	,, 200 m.	0.010
,, 300 m.	0.014	,, 300 m.	0.010	,, 300 m.	0.008
,, 400 m.	0.012	over 301 m.	0.008	over 301 m.	0.007
,, 500 m.	0.011				
over 501 m.	0.010				
2nd class increase	100%	2nd class increase	75%	2nd class increase	50%
1st class increase	200%	1st class increase	175%	1st class increase	150%

Passengers taking express trains are charged express charges in addition to ordinary fares; express charges are of two kinds, Limited and Ordinary. These charges had also been revised twice, once in 1918 and for the second time in 1920. The following are the present charges.

Kinds	Class	Up to 250 miles	Up to 500 miles	Over 500 miles
Limited express	3	Y.1.300	Y.2.000	Y.2.500
... ...	2	2.500	4.000	5.000
... ...	1	4.000	6.000	7.500
Ordinary express	3	Y.0.650	Y.1.000	Y.1.250
... ...	2	1.300	2.000	2.500
... ...	1	2.000	3.000	3.750

(*b*) *Parcels Rates.*—Small goods requiring speedy transportation which can be carried on the luggage cars attached to passenger trains are generally handled as parcels on rates which are comparatively higher than those charges on freights. The consignment as parcels has recently increased considerably, so that the revenue from these sources has come to comprise about 5 per cent. of the total traffic revenue of railways. Parcels rates, as well as passenger and freight rates, had also been advanced twice, once in October, 1919 and for the second time in January, 1921, as follows :—

PARCELS RATES (1 kin—1.32 lbs.)

Weight / Miles	Up to 2 kin	Up to 4 kin	Up to 7 kin	Up to 10 kin	Up to 15 kin	Up to 20 kin	Additional charges every 10 kin increase
	Yen	Yen	Yen	Yen	Yen	Yen	Yen
Up to 50 miles ...	0.150	0.200	0.250	0.300	0.350	0.400	0.100
,, 150 ,, ...	0.150	0.200	0.250	0.350	0.450	0.550	0.200
,, 300 ,, ...	0.150	0.250	0.250	0.450	0.600	0.750	0.300
,, 500 ,, ...	0.150	0.250	0.400	0.550	0.750	0.950	0.400
Above 500 miles additional charges every 300 miles	0.050	0.100	0.150	0.200	0.250	0.300	0.100

(*c*) *Freight Rates.*—Freight rates are fixed according to "differential system" combined "zone system." Zones are widened as the distance increases; zones are gradually increased from the minimum of 2 miles within 50 miles up to the maximum of 30 miles over 1,000 miles, these intervening miles being divided into eight different grades. Freights were formally classified into five classes, namely, 1st, 2nd, 3rd, 4th (high class) and special. The present classification comprises six classes which was revised in January, 1921, *i.e.*, 5th, 4th, 3rd, 2nd, 1st and special.

Service Condition of Employees

I.—THE SCOPE AND NATURE OF THE EMPLOYEES.—The employees in the State Railways, strictly speaking, cover all ranks and classes of employees from the Minister of Railways to a humblest station employee.

They numbered 189,282 at the end of March, 1924. Classes of employees to be mentioned here, however, are only those for actually engaging in works connected with actual service; their number as estimated at the end of March this year was 159,157, divided as follows :

Station employees	58,986
Train service men	14,536
Locomotive engineers and firemen	16,252
Locomotive shed men and car inspectors ..	20,516
Permanent way men	22,633
Shop men and others	26,234

II.—CONDITIONS AND HOURS OF MEN ENGAGED IN ACTUAL SERVICE.—They may conveniently be given according to different kinds of service.

(*a*) *Station employees.*—Service method of these employees according to the nature of service and thickness of works may be briefly described as follows :

Day service.—They are to report every day at a fixed time (in most cases 8 a.m.), serving for a fixed number of hours a day, with holidays four times a month or once in a week. The average working hours a day of those employees are 9 hours and 16 minutes.

Day-and-night through service.—They are to serve continually for 24 hours, followed by a rest of 24 hours, this to be repeated. During night service they have a sleeping time from 2 to 4 hours. They are given a holiday of one day every month. Their average working hours a day are about 10 hours.

Shift service.—This is a method of having day service followed by day-and-night through service so that it requires at least three men to shift. Their average working hours a day are 10 hours 38 minutes.

Three shift service.—24 hours are equally by this method divided and shifted by three men with an average working hours per day per night for each (including time spent in transferring works) of 8 hours 16 minutes. This three shift system is applied for places requiring comparatively thick work.

(*b*) *Locomotive and train men.*—Locomotive men include engineers and assistant engineers (fire-men); train men include conductors, and brake-men, etc. Their service is on shifting system. Number of days required one round of shift is 2 days at least and 20 days at most, most prevalent shift is 10 days.

The working hours per day for each man, which is obtained by dividing the total working hours during shifts by the number of days of shift are as follows ;

	Locomotive engineers	Firemen	Train men
Minimum	7 hrs. 48 min.	7 hrs. 48 min.	8 hrs. 30 min.
Maximum	8 ,, 18 ,,	8 ,, 24 ,,	9 ,, 21 ,,
Average	8 ,, 6 ,,	8 ,, 6 ,,	8 ,, 50 ,,

These averages include hours spent on either locomotives or trains, in cleaning boilers (by engineers or by firemen), changing one train for another, preparing for duty aboard and straightening up matters after the finish of works.

(*c*) *Locomotive shed men and car inspectors.*—They include those serving in the locomotive sheds, car inspectors so forth, and their manner of service and working hours are the same as prescribed for station employees.

(*d*) *Permanent way men.*—The working hours of permanent way men are fixed as follows, taking into consideration variation in season :—

From November to February, following year	9 hours per day
From March to April and from September to October	10 ,, ,, ,,
From May to August	11 ,, ,, ,,

Averaged in one year (365 days) this becomes 10 hours per day.

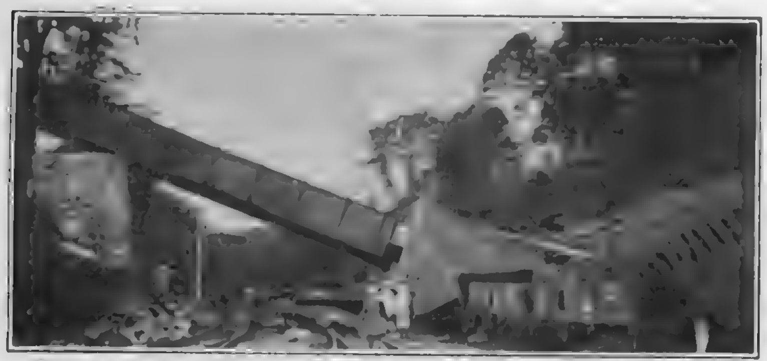
In cases of those working in tunnels, 8 hours are prescribed for each day.

2 holidays are given each ordinary month and 4 times during each of the special months, December and January.

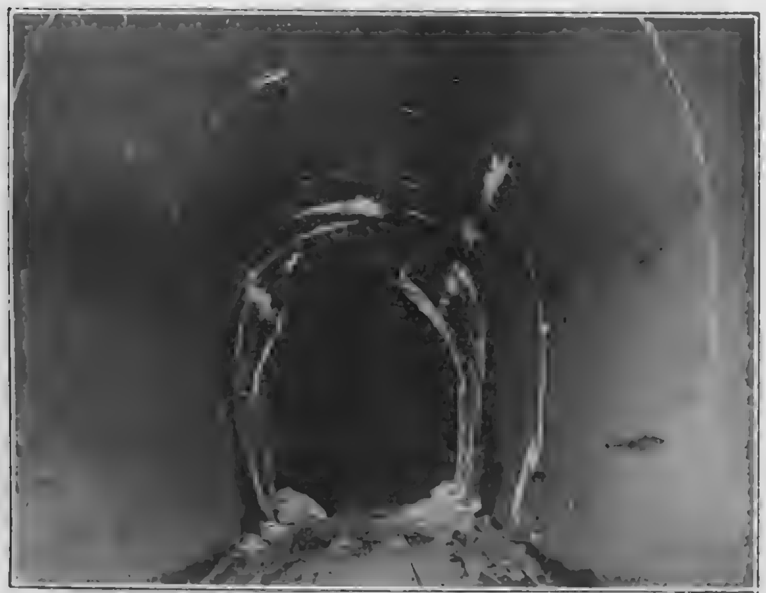
(*e*) *Shop men.*—There are the workers in car-building and repairing shops, their service hours are 10 hours per day, but the actual working hours are 9 hours. They are given at least 2 holidays in a month; they are actually having at present 4 holidays each month.

III. EXTRA HOLIDAYS.—In addition to the regular holidays mentioned above, from 3 to 9 continuous holidays are given all employees who have a clear record of attendance for 6 months.

IV. SALARIES AND WAGES.—(*a*) Following are the wage scales in percentage paid to the employees below the rank of foremen (the rest being accorded the treatment of the civil officials) :—



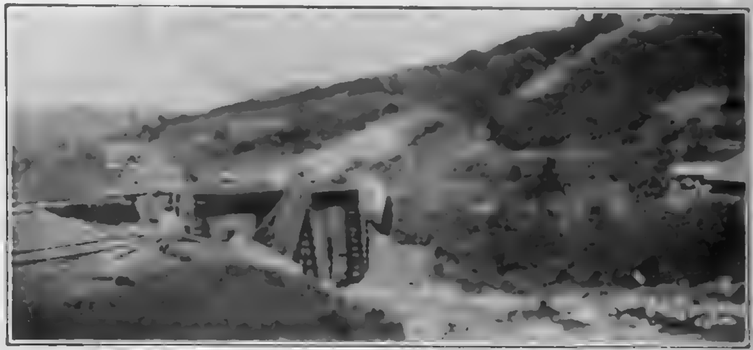
Falling sidewise of highway bridge pier upon a freight train, crushing and overturning some cars, near Odawara, on the Atami Line



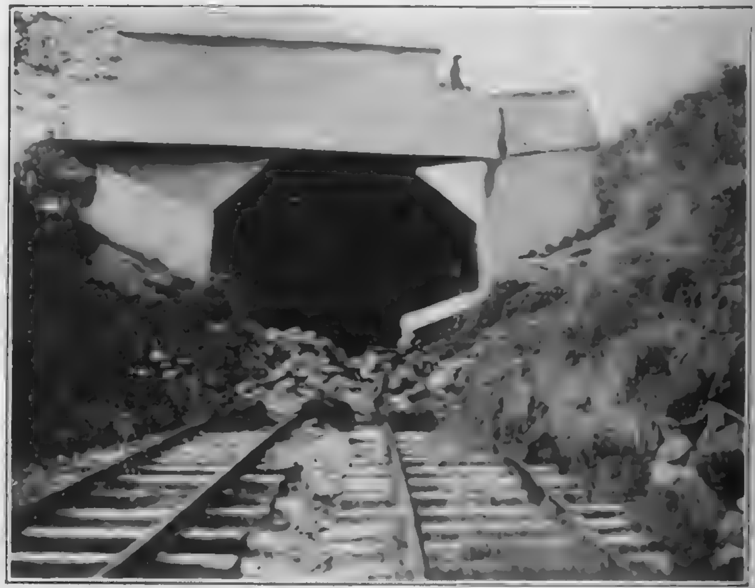
Cracking and partial falling of Nokogiriyama tunnel, between Hamakanaya and Hota, Boso Line

Falling of embankment and cuttings and damming the river near Ochanomizu Station, Tokyo

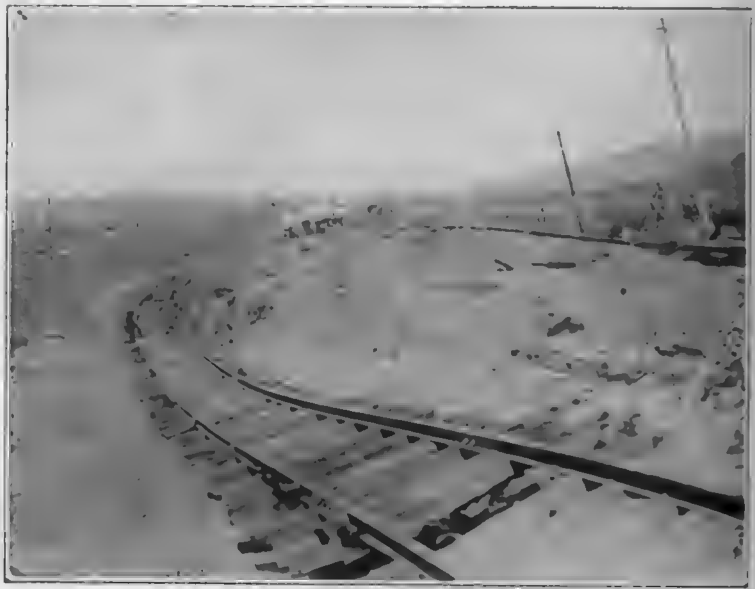
Year	Foremen	Employees of *koin* class	Employees of *yonin* class
1912	100	100	100
1913	100	101	101
1914	103	103	105
1915	109	99	106
1916	116	100	106
1917	113	104	115
1918	120	123	130
1919	126	134	145
1920	179	214	234
1921	243	266	302
1922	243	275	294
1923	240	274	290



Falling of girders of Aizawa bridge, between Suruga and Ashigara, Tokaido Line



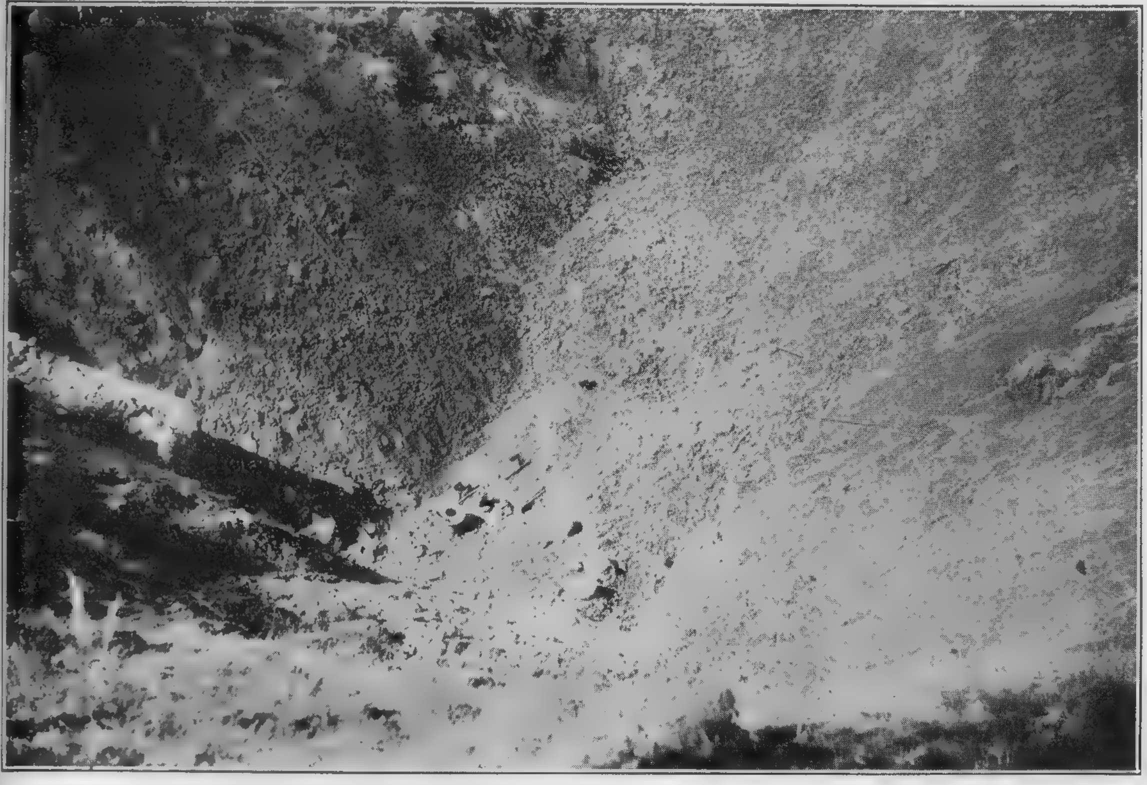
Eastern entrance of Komine tunnel as it looked after the quake



Collapse of embankment and falling of down-line track, between Kozu and Shimosoga, Tokaido Line

(*b*) *Long service bonus.*—A system of 'long service bonus' has been established since September, 1919 as an incentive to long and continuous service, by which Y.2 are added to monthly wages for those serving continuously over five years, Y.3 for those serving continuously over 10 years, Y.4 for over 15 years, Y.5 for over 20 years, Y.6 for over 25 years.

(*c*) *Other bonuses.*—In addition to the above wages and long service bonus, a bonus is given to every employee twice a year, that is, June and December, varying in amount from one month's to 1½ month's wages each time. Further, night service pay for working in night, or train service pay for those serving aboard



Collapse of Samunomeyama Tunnel between Nebukawa and Manazuru, Atami Line, seen from the eastern entrance. Stone column-like object lying at the left-hand side is the top of the entrance arch of the tunnel; a passenger train was just passing through and was about to emerge from the tunnel when it met the disastrous earthquake. The top of the locomotive is just seen, the rest being buried; the whole of the passenger cars were completely swallowed up under tons of earth and gravel within the tunnel

trains, couplers extra pay for couplers and an extra pay to the ticket booking clerks are also allowed.

V. Employees' Representative System of the State Railways of Japan.—The representative system is covered by the Employees' Committee representing men engaging in the work directly connected with the operation of the railways.

The Committee consists of members elected by the three classes of employees, namely *Tetsudoshu* (railway foremen), *Koin* and *Yonin*, and forms a medium through which the opinion in answer to the queries submitted by the executive side and the complaints for the sake of common interests of these classes of employees are secured.

This system has been adopted in May, 1920; its object being to effect mutual understanding between executive side and common employees in order to promote smooth and cheerful spirit in pursuit of their works and raise the efficiency of operation of the State Railways.

This organization, briefly stated, embraces 136 districts, in each of which an Employees' Committee is formed (this is conveniently called a Local Committee). Number of members comprising a Local Committee ranges from 5 to 30, the exact number to be fixed according to the number of employees within the prescribed district. Each committee district is further divided into several election sections for each of which number of the committee members are assigned.

They are at present 136 local committees with total number of members of 1,439. Term of committee members are 2 years.

Each local committee co-opts representatives numbering from 1 to 3, these co-opted members to organize a Joint Employees' Committee for each Regional Office. The position of the chairman of the Local Committee is filled by either the Chief of the District Traffic Office or the Chief of the District Maintenance Office or the Superintendent of Workshops and that of the Joint Committee by the Chief of General Affairs Section of the Regional Office. Officers of the Committee who have actual experiences with the services directly connected with the operation are also permitted to participate in the employees' meeting and make proper explanation and response. Decision on the bills submitted for discussion, however is reached by the elected members of the committee alone, the chairman and others, not members of the committee, having no power to cast vote beyond offering their explanation.

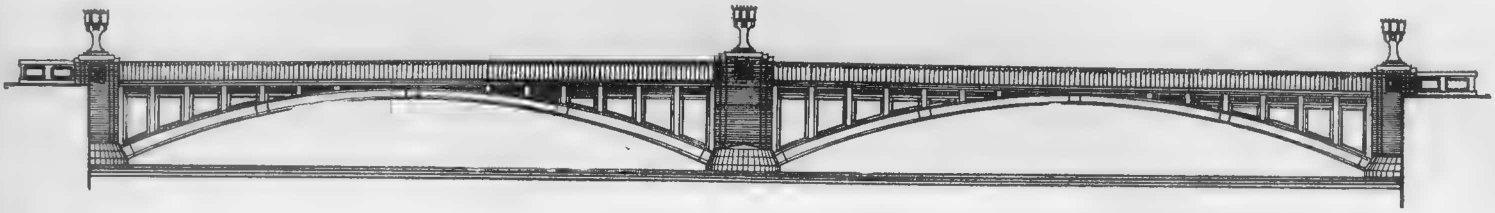
The Committee meetings are to be held twice a year. The 8th meeting has been held. The opinions submitted at the meeting by the Committee have made a valuable contribution towards better planning, and for the future of the State Railways; the decision secured at the meetings, resulting in their adoption promoted not to a little extent general welfare of the employees.

Summary of Lines Planned for Construction

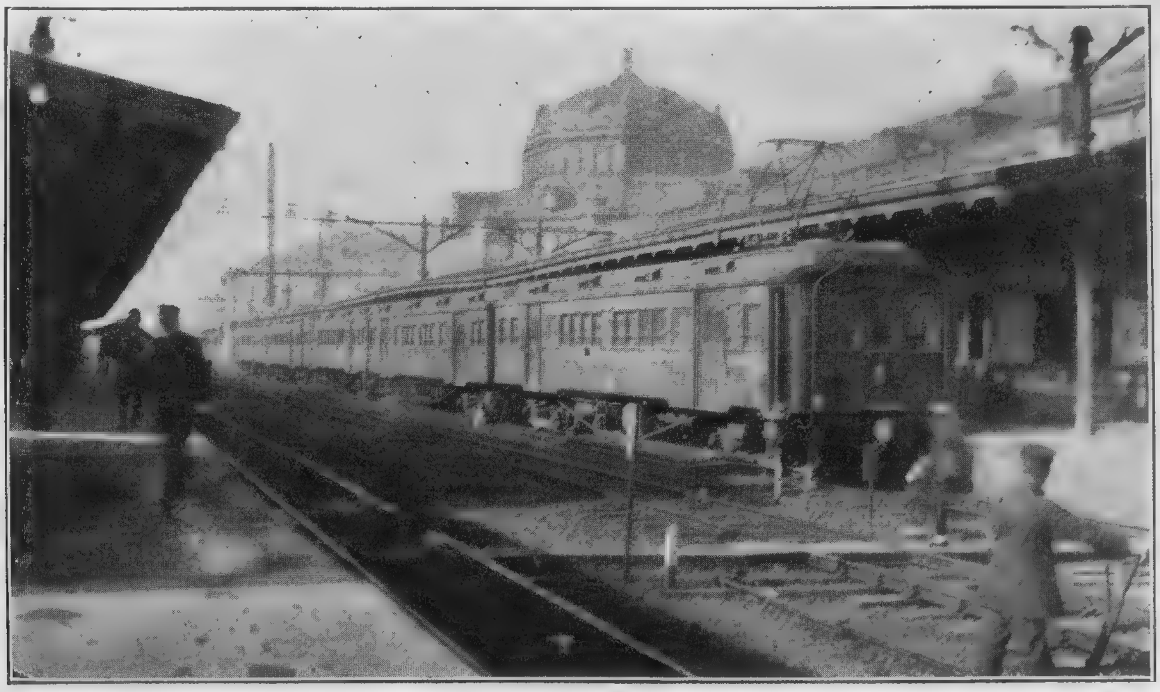
There are 87 lines planned for construction or extension by the Railway Department of Japan, the total length of which is 3,562 miles. The construction work has been hindered to great extent owing to the earthquake of September, last year, but the work has been gradually restored to normalty so that at the end of October, 1924, 525 miles of line have been completed and opened for traffic; and 557 miles are being built of which 165 miles are to be completed and opened at the end of this year.

A part of work being executed under contract and the rest being under direct supervision of the Department; the number of the sections of the former is 54 with the estimated expenditure of more than Y.24,710,000 and that of the latter is 15 with an estimate of more than Y.40,530,000, making the aggregate more than Y.65,240,000. The completion of the remaining will have to be postponed for some period on account of the earthquake. We, however, expect the whole lines planned will be completed and opened for traffic in ten years or so.

As most of the lines now under construction are in mountainous regions and country districts, we must bore many tunnels and consequently encounter many difficulties in pushing our works. The number of tunnels which are more than 2,000-ft. in length on those lines under construction is 24, totaling 154,900-ft.; and that of bridges now under construction is 74, totaling 33,600-ft. in length.



The New Edo Bashi in Tokyo



Multiple Unit Train Standing at Tokyo Central Station

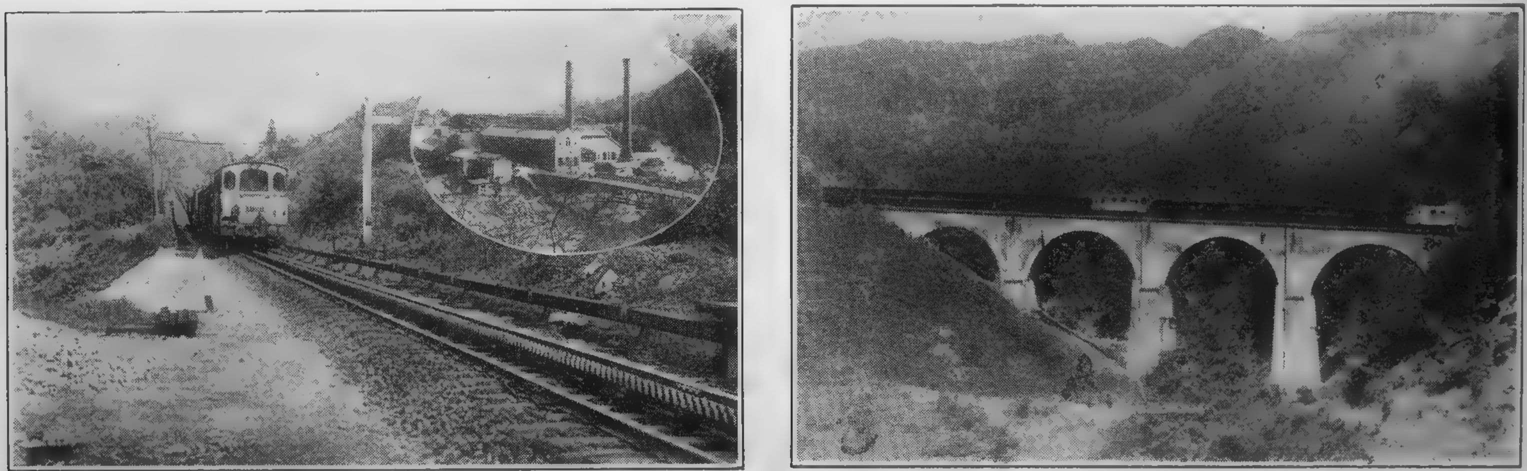
Japan's Railway Electrification Program

A Huge Scheme Held Up Awaiting Adequate Power Development

THE vast program of electrifying the State railways of Japan has received a temporary set-back owing to the attitude of Dr. Senjoku, the new Minister of Railways, who holds the belief that the supply of electric power is inadequate to insure steady and efficient operation of the train services. Although heartily approving the completion of the program for electrifying the Tokyo district and those sections of the main line on which work has been commenced, in order to show the public how valuable the electric train service can be made if properly managed and supplied at all times with an adequate amount of power, the new Minister is opposed to any extension of the scheme that will compromise the main Tokkaido line to the use of electricity until it can be demonstrated that ample power will be available for the uninterrupted operation of this vital artery of communication.

The problem which he has been called upon to face is one created by the long dry seasons in Japan, when the generating capacity of the waterpower plants is either materially curtailed or cut off altogether for lack of sufficient water. The necessity of an assured power supply to meet the rapidly increasing industrial demands and the more vital requirements of the railway electrification scheme can only be met by creating enormous impounding reservoirs in the mountain districts, or by erecting steam generating plants near the center of demand. The cost per kilowatt to install and equip a high-power hydro-electric station in Japan with its long-distance transmission lines, sub-stations and other requirements, ranges from Y.600 to Y.1,200, while that for steam generating plants erected at strategic centers in the industrial districts is about Y.150 per kilowatt.

As a consequence of these mounting costs for hydro-electric installations and the equally large sums required to build the storage reservoirs that will guarantee their continuous operation the year round, there is a growing tendency to regard the centrally located steam plant as the more dependable source of power for such enterprises like the State railways, where any suspension of the service would seriously menace the economical life of the nation. These considerations seemed weighty enough to influence Dr. Sengoku to call a halt to the electrification program in order to make certain



Over the Usui Pass: The First Electrified Railway Line in Japan

Train Approaching a Station. (Inset) Steam Power Plant at Yokogawa

Crossing a Valley

in advance that nothing would occur to interfere with the steady operation of the railways.

This decision threw a wet blanket over the hopes of the hydro-electric power companies and has spurred them to renewed activities to increase their water-power output and erect steam-power reserve plants of such capacity as will meet at all times the demand for current. Desiring to be independent as far as possible of the private power producers, the railway authorities obtained water rights on the Shinano River and approved the plans for the erection at that point of a 160,000-kilowatt power station, the power to be transmitted to sub-stations and there transformed to 1,500 volt direct current for the operation of the various sections of the main Tokkaido railway. Considerable progress had been made in preparing the site for the erection of the plant when the order was issued to suspend further construction. This was influenced by the uncertainty surrounding the storage capacity of the ponds on which the plant would be dependent for a continuous supply of power. This and other considerations will determine whether two plants of 80,000 k.w. each, or a single plant of 160,000 k.w., will be erected.

However, these set-backs appear to be only temporary, as the larger power producers, like the Tokyo, Daido, Toho and their subsidiaries, are forging ahead with plans for the erection of several large steam plants to meet the demand for power. The day is not far distant when electrification of the main railways can be taken up anew and pushed forward to completion with the full assurance that power in ample quantity will never be lacking.

The first section of Japan's State Railways to be electrified was that part of the Shin-yetsu Line crossing the Usui Pass (one of the steepest in Japan), the highest point reaching 3,086-ft. above sea-level. This work was carried out in 1912, and covers that part of the line between Yokogawa and Karuizawa, where the difference in level is 1,817-ft. in seven miles, a gradient of 6.7 per cent. No less than 26 tunnels, aggregating 2.8 miles in length, had to be driven in this short distance, and for a matter of 5.2 miles the rack rail system had to be applied.

One of the A.E.G. Electric Locomotives on the Yokogawa-Karuizawa Section of the Shin-yetsu Line

Power for this section is derived from a steam power plant erected at Yokogawa, equipped with three 1,000 k.w. General Electric (U.S.A.) turbo generators which furnish current at 6,600 volts 25 cycles. Two sub-stations, located at the highest and lowest points of the line, transform the current to 240 volts, 6-phase, and two 450 k.w. rotary converters convert it to 650 volts direct current. They are also equipped with 312 storage batteries having a capacity of 1,320 ampere hours, designed to buffer the fluctuations of the load in connection with a k.w. 100 Pirelli automatic reversible booster.

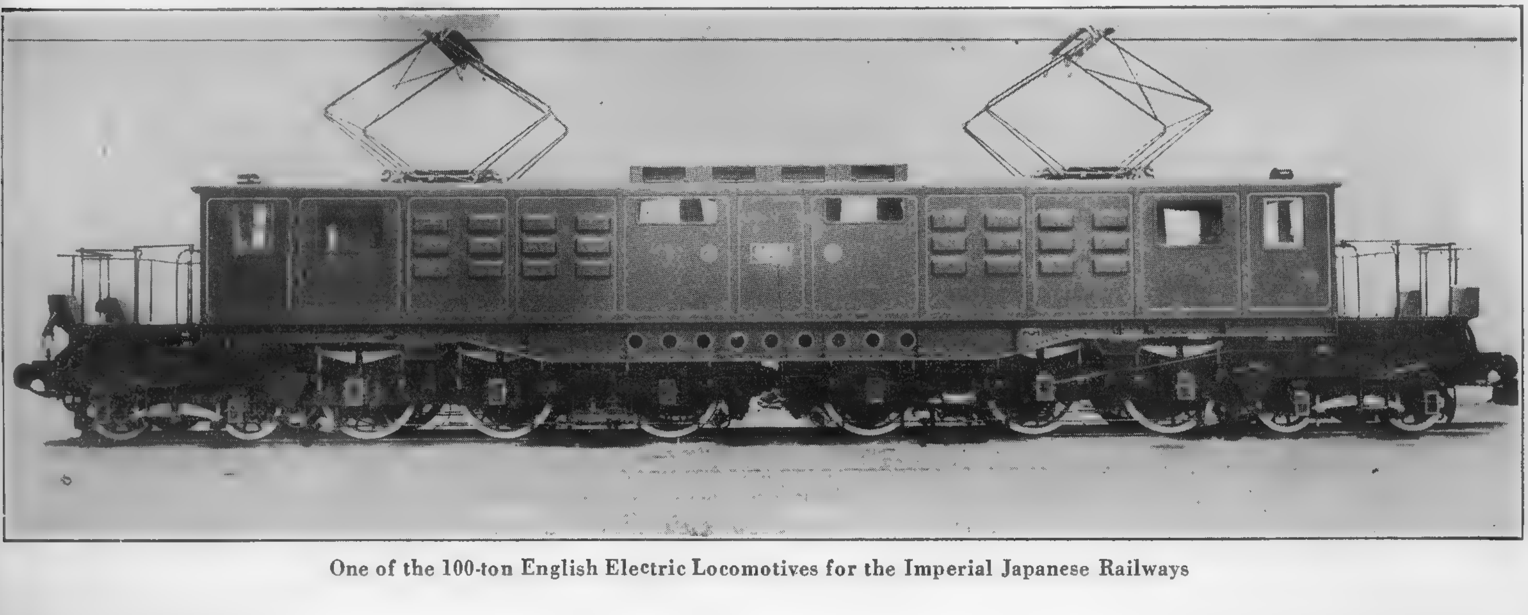
The rack locomotives, made by the A. E. G. of Berlin, weigh 42½ tons each and are capable of drawing eight cars at 11 miles per hour up the 6.7 per cent. grade. Each locomotive is equipped with two 330 h.p. direct current motors. Several similar electric locomotives were subsequently built for this service at the Oimachi shops of the Government Railways.

From this initial step towards electrification to the present day, many plans for the expansion of electric operation have been presented and discarded until a definite scheme received approval and was partially carried out when held up because of the uncertainty of acquiring a steady supply of power.

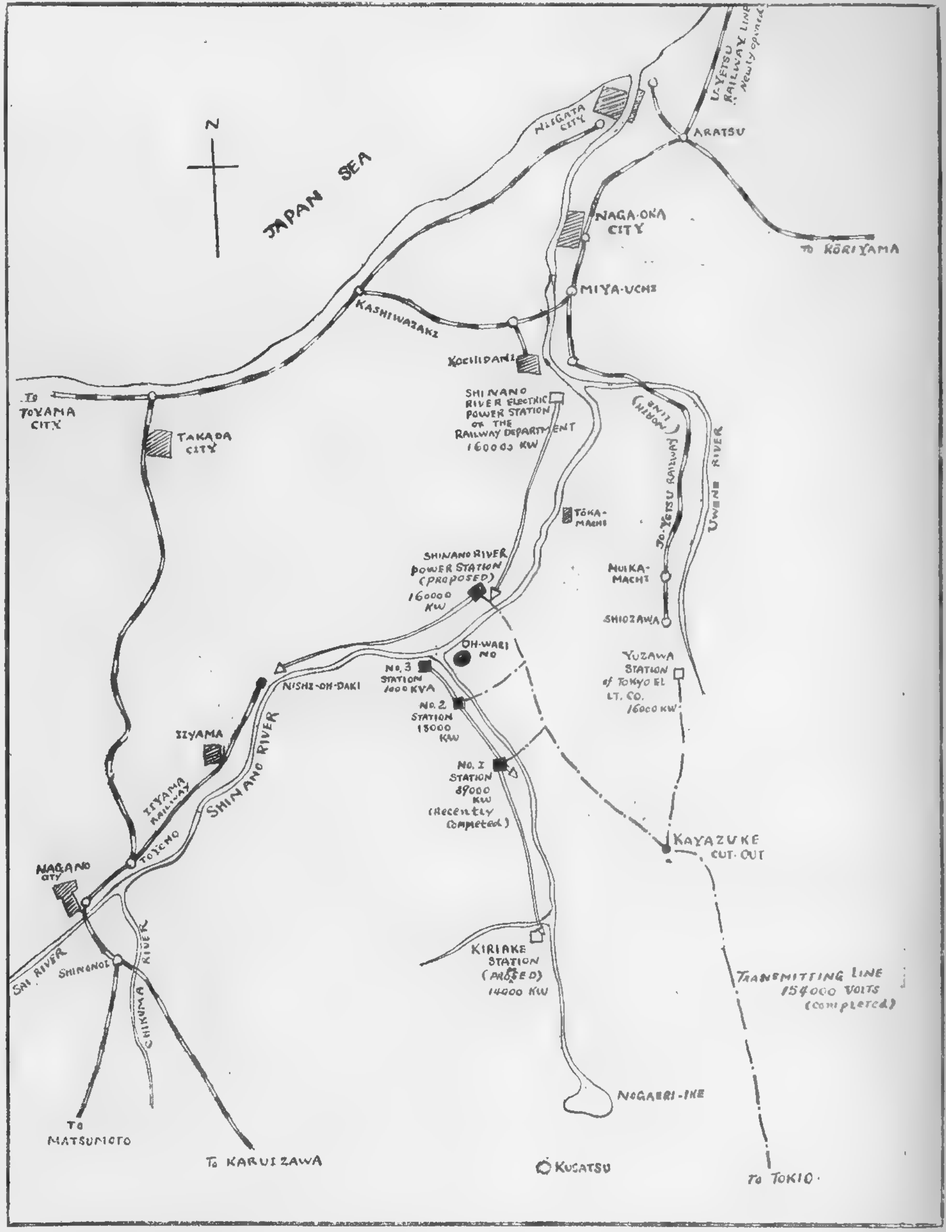
The history of the decision to make the change from steam to electricity is interesting. Far-sighted engineers and officials of the Imperial Government Railways sought to find a way to increase the traffic facilities and to reduce the cost of operation to take care of the ever-increasing traffic which obviously would be, within the period of a few years, beyond the capacity of the available equipment.

The capacity of Japanese railways is limited greatly by the narrow 42-in. gauge which had been adopted as standard. One of the most natural changes to consider was the widening of this gauge to 4-ft. 8½-in. or even 5-ft.

This change was advocated very strongly by one group of engineers, but it was found to be an almost impossible and extremely costly undertaking. Besides the actual increasing of the distance



One of the 100-ton English Electric Locomotives for the Imperial Japanese Railways



Map of the Shinano and Nakatsu River District, showing the Power-house Sites of the Shinyetsu Electric Power Company feeding into the Joetsu Tramsmission Line of the Tokyo Electric Light Company, and the Site for the projected 160.000 k.w. Power Plant for the Imperial Japanese Railways.

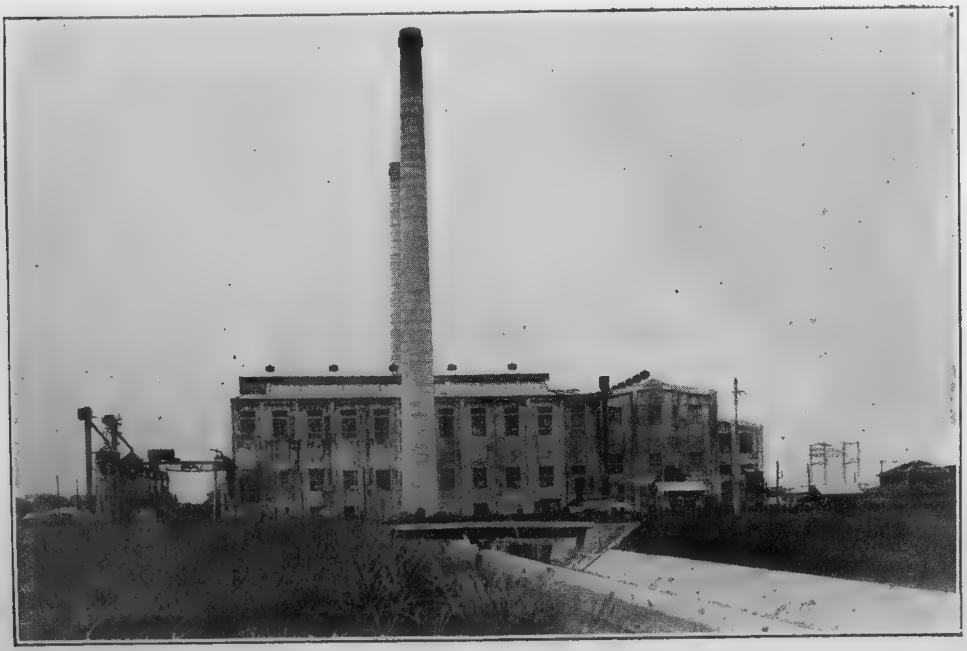
between the rails, this change would involve the widening of tunnels and of all right-of-way, changing bridges, stations, and, most important of all, the discarding or altering of all rolling stock. Furthermore, the period of transition, which would of necessity be of long duration, would so upset the movement of trains as practically to paralyze business.

The electrification of railroads in other parts of the world and the glowing reports of their success drew the interest of these engineers, and an American engineer, Mr. H. K. Smith, of the Westinghouse Electric and Manufacturing Co. (U.S.A.), who had been actively associated with many of the extensive developments in the United States, was engaged as consulting engineer for the Imperial Government Railways. He studied the matter of electrification and made complete and detailed recommendations for equipment adequate to handle the prospective growth in traffic for many years in the future.

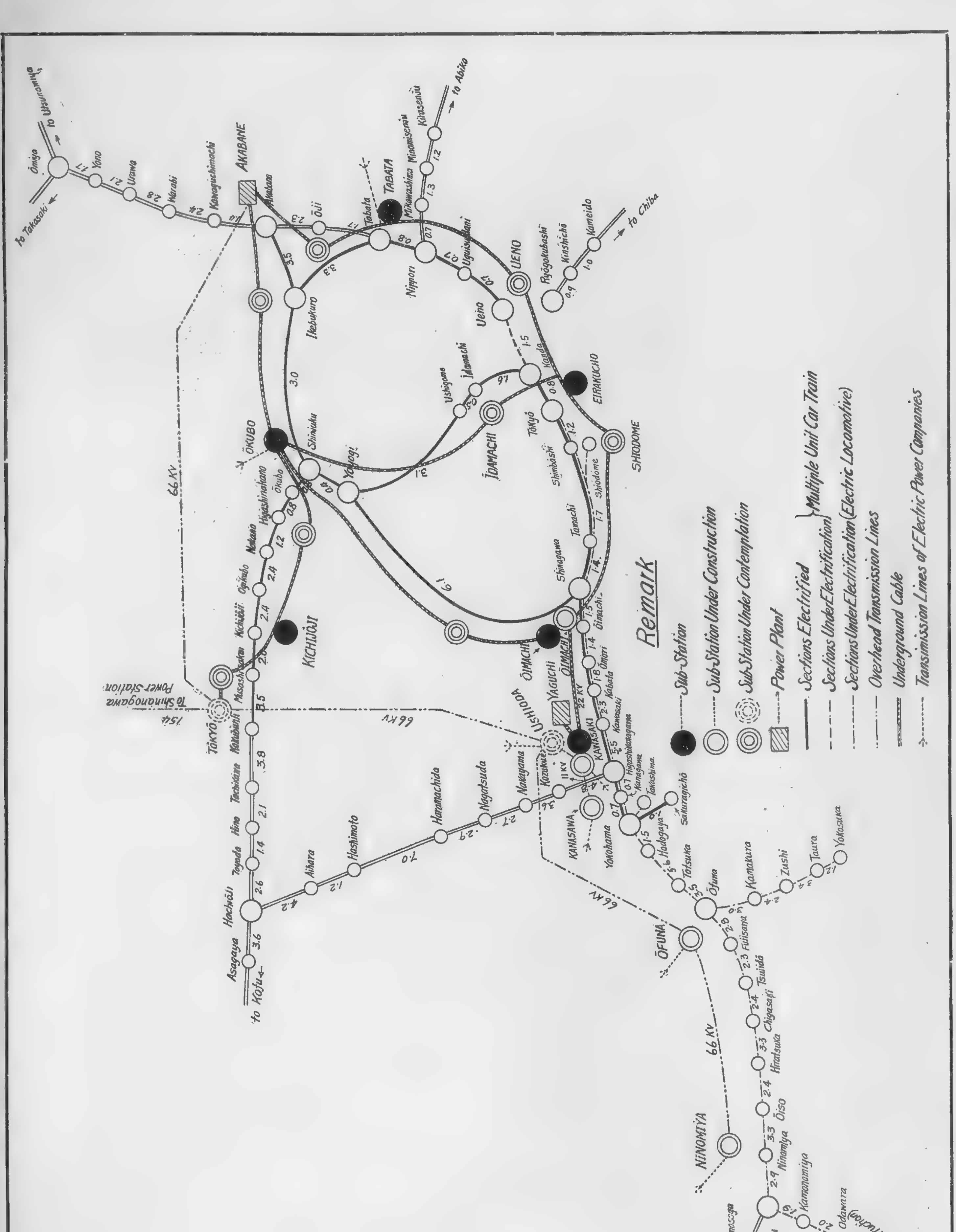
A systematic plan covering a number of years was laid out which, with one or two exceptions, has been followed. This plan consisted roughly and briefly in the purchase of a few experimental locomotives which could be tested, inspected and used as a basis of study. After having these concrete examples, definite and unbiassed decisions could be reached covering the requirements for future needs. At this point an order was placed with the English Electric Company for 36 locomotives and other orders for sub-station equipment placed with various manufacturers. Progress of the electrification plans was materially checked by the earthquake of 1923, which caused such damage to the railway property that all attention was centered on rehabilitation. However, the culmination of all these plans has been the ordering of light passenger locomotives and a large amount of sub-station apparatus with automatic switching equipment from the Westinghouse Electric and Manufacturing Co., four freight locomotive and other important equipment from the General Electric Co., and two local passenger locomotives and sub-station appliances from the Brown-Boverie Co.

The scheme for electrifying the railways follows the normal development of the metropolitan transportation lines, starting with the defunct Kobu Railway, which in 1905 electrified the city portion of its line from Manseibashi to Nakana, a distance of eight miles. The railway authorities, in order to cope with the rapidly increasing transportation needs of the metropolis, then took up the investigation of electrification and applied it to the Yamate and Tokyo-Yokohama lines. The Yamate line, so-called, is that part of the State railway service which branches off the main Tokaido line at Shinagawa and encircles the city of Tokyo, bifurcating at Ikebukuro, one branch leading to Uyeno and the other proceeding to Akabane, 6.2 miles north of Uyeno. This belt line, constituting the present rapid transit system for the capital, is carried for the most part on elevated tracks.

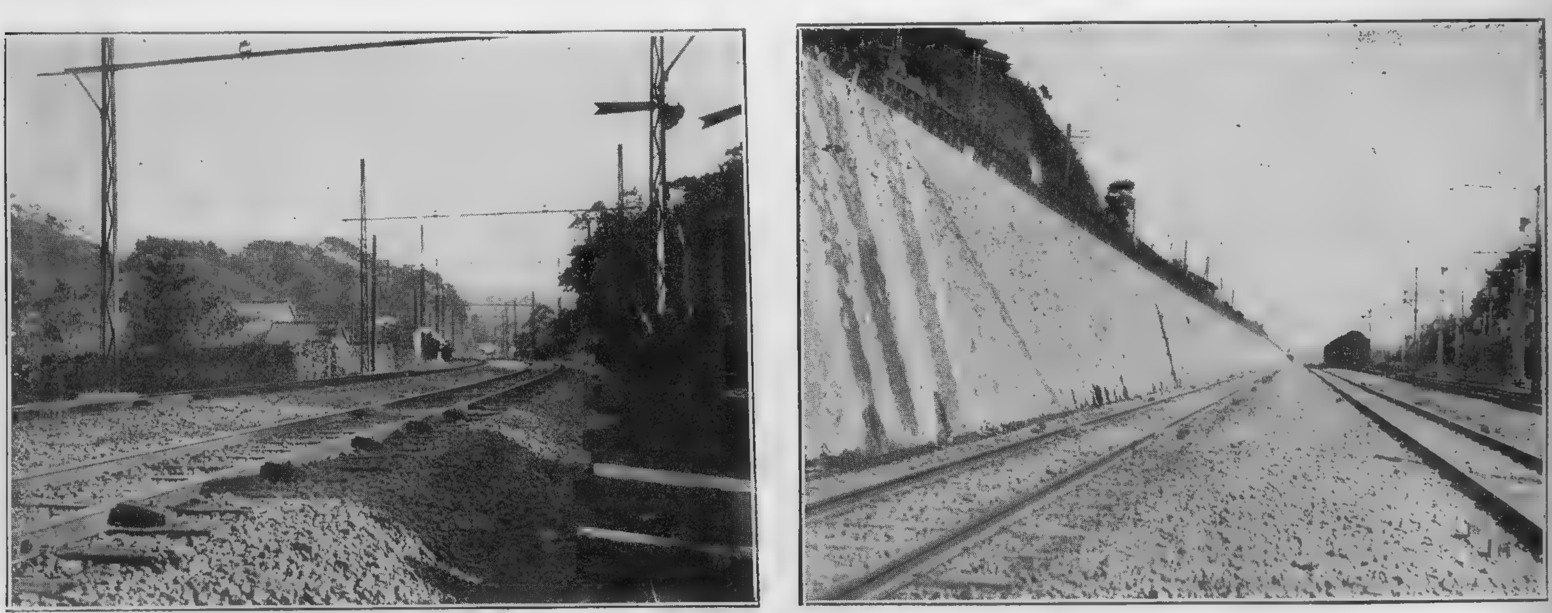
The line between Tokyo and Yokohama was then electrified and a new double track laid alongside the existing steam lines. This work was completed in May 1915, and the plans then extended to electrify the main Tokaido line as far as Odawara, with a branch from Ofuna to Yokosuka. Since then, other extensions have been added, so that at the present time (July 1925)



Akabane Steam Power Plant of the Imperial Japanese Railways



Map Showing the Electrification Scheme of the Imperial Japanese Government Railways in the Tokyo-Yokohama District.



Road Bed and Overhead Construction

Ofuna-Yokosuka Section, near Kamakura

Between Higashi Kanagawa and Kanagawa

the following sections of the urban and inter-urban lines of Tokyo are being operated with four and five-car electric trains hauled by motor cars:

Tokyo-Sakuragicho (Yokohama)	19.2 miles
Shinagawa-Uyeno	15.00 ,,
Ikebukuro-Akabane	3.5 ,,
Tokyo-Kokubunji	19.5 ,,
Total	57.2 miles

During the rush hours of morning and evening, multiple unit car trains, each composed of five bogie cars, are run at intervals of three minutes, with a maximum speed of 54 miles per hour or a schedule speed of 24.5 miles per hour.

The power required for operating these State-owned electric lines in the Tokyo district is derived from two Government plants, one at Yaguchi and the other at Akabane, supplying a total of 24,000 k.w. In the event outside power is necessary, it is purchased from the Tokyo Electric Light Company and the Tokyo Municipal Electric Bureau.

The Yaguchi Power Plant, of 6,000 k.w. capacity, is located about half-way between Tokyo and Yokohama, about a mile off the railway, and is the only gas producer power station in Japan. The generators, four in number, are from the English Electric Company, each 1,500 k.v.a., 3-phase, 11,000 volts, 25 cycles, 94 r.p.m. direct connected to four Lilleshall gas engines capable of developing 2,163 effective h.p. Gas is supplied from four sets of Mond gas producers with ammonium sulphate recovery apparatus.

The Akabane Power Station, located to the north of Tokyo, has a total capacity of 18,000 k.w. and is equipped with three Westinghouse 6,000 k.w. turbines and Babcock and Wilcox boilers.

The 11,000 volt high pressure transmission between power stations and sub-stations is carried by underground cables.

The next step on the part of the railway authorities was to extend the electrification to the main Tokaido Line running between Tokyo and Kobe. This is a distance of 353.2 miles by rail, and serves the most important commercial, industrial and agricultural sections.

The first phase of this plan will be the electric operation from Tokyo to Odawara, to be completed by the summer of this year, at first by the operation of all local passenger trains and later to include all train movements in this zone. This will also include the branch line from Ofuna to Yokosuka, a distance of 10 miles. Multiple unit trains will be used as at present between Tokyo and Yokohama.

The mainTokaido line is double track throughout, well ballasted, and in excellent state of repair. The track is 42 in., a gauge that has required the construction of much new electrical equipment. The Tokaido steam line is supplemented between Tokyo and Yokohama by the double track electric line on which high speed multiple unit trains have been operated at 1,200 volts since 1914. The new electrification will all be at 1,500 volts D.C., and the present installations will be changed over accordingly.

Road Bed and Overhead Construction

Between Totsuka and Ofuna

Entering Tokyo Central Station

Ofuna Transformer Station

A very important part of this electrification plan is the rejuvenation of the local belt line service of the Government railways around Tokyo. Until early this year this entire loop system had been operated at 600 volts D.C. There is now under way, however, a transition which will ultimately place all of these lines in 1,500 volt operation. The transition is being carried out as follows:

All new motor equipments are being purchased for 1,500 volt operation. The old 1,200 volt cars which were in operation between Tokyo and Yokohama are arranged for full speed operation on both 1,200 volts and 600 volts. These cars were transferred to operation on the belt line from Tokyo Station to Shinagawa to Uyeno, which was changed to 1,200 volts. The cars which were formerly in service on all the belt lines at 600 volts only were transferred to the cross city line between Tokyo, Shinjuku and Kokubunji.

This is the present status of operation. When the Tokaido line is opened for electrical operation at 1,500 volts the Tokyo-Yokohama line will also be changed to 1,500 volts. At such time as the condition of the old 600-1,200 volt and 600-volt cars will warrant their being discarded, the entire system will be changed to 1,500 volt operation. This scheme of transition will make it possible to use all of the present equipment to the full extent of its usefulness, and will eventually secure a homogeneous and unified system.

The extension of the electrification between Tokyo and Odawara, 52.1 miles, and the ten-mile Ofuna-Yokosuka branch adds another 62.1 miles to the 57 already in operation. This work was started in August 1922 and is scheduled to be completed in June of this year. To provide for this expansion, the Government proposes to increase its own power supply by the erection of a new 50,000, k.w. steam plant to be located at some suitable point along the Tokyo-Yokohama section. The plans for this station have been prepared, but tenders have been postponed in accordance with the general retrenchment program for the present year.

For the first 57 miles of electrified sections, six sub-stations had been erected at Tabata, Eirakucho, Okubo, Kichijoji, Oimachi and Kawasaki, but to meet the requirements of the new extension to Odawara and Yokosuka, eight new sub-stations are being constructed at Oimachi, Kawasaki, Kanagawa, Ofuna, Ninomiya, Uyeno, Iidamachi and Shiodome, with six more projected as shown on the map accompanying this article. The greater part of this machinery has already been ordered and installed. The total capacity of all these sub-stations is as follows:

Eirakucho, 6,000 k.w.: Shiodome, 8,000 k.w.: Oimachi, 6,000: New Oimachi, 8,800: Okubo, 6,000: Uyeno, 6,000: Tabata, 4,000: Iidamachi, 6,000: Kichijoji, 2,000: Kawasaki, 3,000: New Kawasaki, 8,000: Kanagawa, 8,000: Ofuna, 8,000; and Ninomiya, 6,000, a total of 85,800 kilowatts. In addition to this, another station of 4,000 k.w. capacity is to be installed at Yugawara, on the Atami cut-off. The equipment for this station has been ordered from the Westinghouse Electric and Manufacturing Co.

The equipment of five of these new sub-stations is as follows:

Oimachi: Capacity 8,800 k.w.; receiving voltage, 11,000, 50 cycles. Five Westinghouse 1,000 k.w. 6-phase compound wound rotary converters operating at 750 r.p.m. and delivering current at 750 volts, with two Westinghouse 2,100 k.v.a. transformers, three phase delta connected in the primary winding and six phase diametrical connections in the secondary. The primary voltage is 11,000 and secondary 530. There are also six 800 k.w. Brown-Boveri mercury rectifiers with 1,500 d.c. voltage output, receiving power from three 2,000 k.v.a. transformers, three phase with connections in the primary and double-six phase and double Y connections in the secondary. The primary voltage is 22,000 and 11,000, and the secondary is 1,370 and 1,090. This station was completed in April 1925.

Westinghouse Electric Locomotive hauling Passenger Train on the Imperial Government Railways

Kawasaki: Of the sub-stations erected to supply trolley power perhaps the most important—owing to its capacity and location—is that situated at Kawasaki. Building operations were actually commenced early in 1923, but, being situated in the earthquake zone, it suffered very considerable structural damage, as did all other constructional work during that eventful period.

The Kawasaki sub-station will supply power at a direct current pressure of 1,500 volts to the

Tokyo end of the main line, and accordingly will be of primary importance owing to the very heavy passenger and freight traffic in that zone. The incoming 3 phase 50 cycle supply for this sub-station is obtained from the Tokyo Electric Light Company at a pressure of 66,000 volts. This is stepped down to a pressure of 11,000 volts by means of a bank of single phase outdoor transformers of Hitachi manufacture, together with the necessary outdoor oil circuit breakers, isolators and structural steelwork for supporting same. The transformers are of the water cooled type, each designed for a continuous output of 3,000 k.v.a. Owing to the lack of water, elaborate and efficient arrangements have been made for circulating cooling water by means of specially constructed concrete cooling ponds located near the building property.

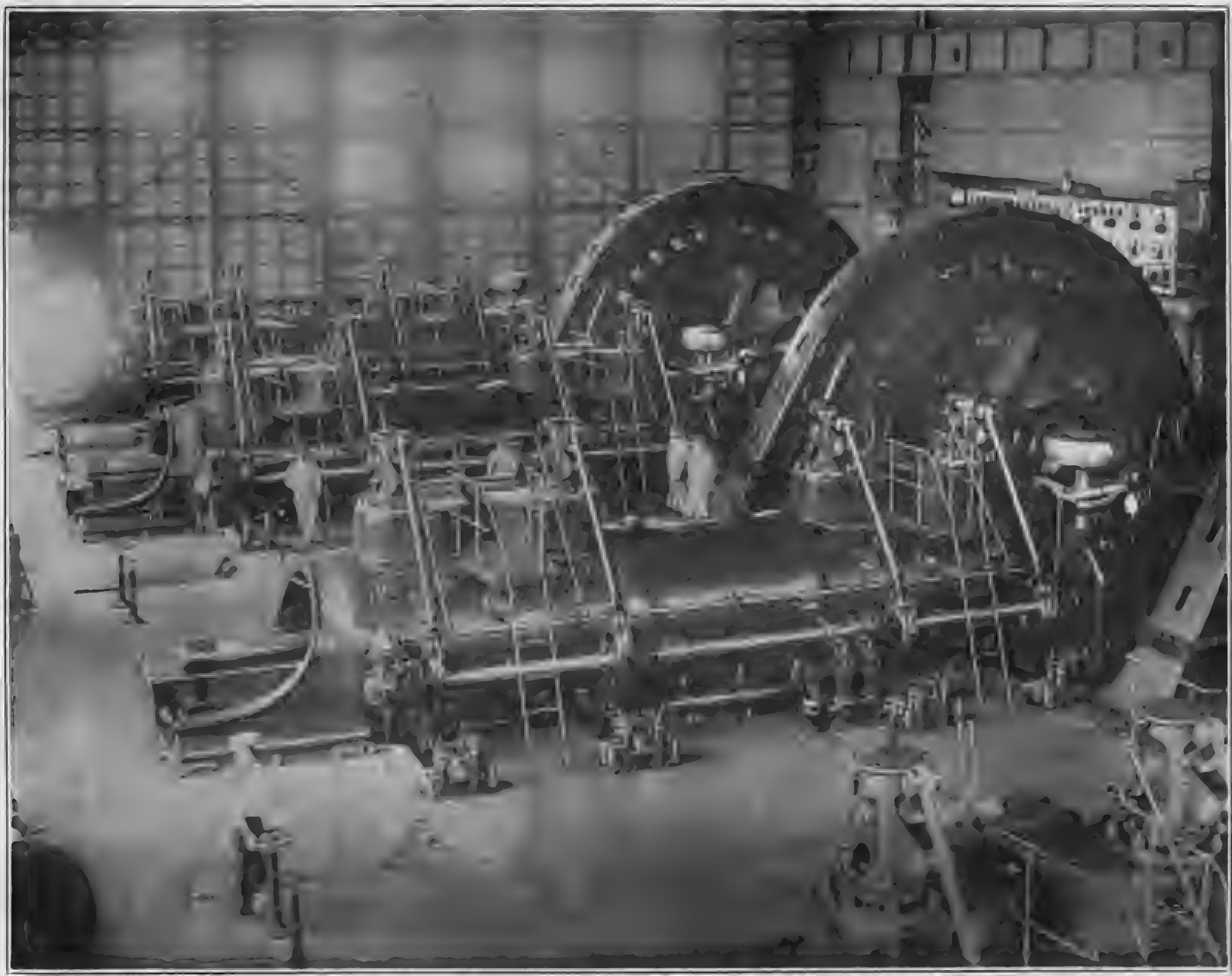
Arrangements have been made for an additional incoming feeder to be installed at some future date when necessity arises.

The sub-station proper is equipped with rotary converter plant of the latest design and is capable of giving a continuous output of 8,000 k.w., with a peak of 24,000 k.w. momentarily.

Installed therein are eight rotary converters of English Electric manufacture, each designed to give 1,000 k.w. at 750 volts and running at a synchronous speed of 750 r.p.m. They are arranged to run in series of pairs, each pair supplying 2,000 k.w. at 1,500 volts D.C. The design of these machines conforms with the English Electric Company's standard practice, each being fitted with roller bearings and arranged for self-starting without the aid of brush lifting or field splitting devices. The above is somewhat of a departure from usual practice, and the starting operation is greatly facilitated thereby.

Four indoor type O.I.S.C. transformers—also manufactured by the above company—supply power at the requisite voltage to the above rotary converters. Each transformer is rated at 2,200 k.v.a. and steps down from a voltage of 11,000 volts. They are of the double wound secondary type, each to feed a series pair of 1,000 k.w. rotary converters.

Both the E.H.T. and D.C. switch-gear installed is of English Electric manufacture and consists of two incoming feeders and four transformer remote electrically controlled equipments mounted in very substantially constructed stonework cubicles. Each oil circuit breaker is capable of a rupturing capacity of 200,000 k.v.a. with the solenoid operating gear mounted in front of each circuit-breaker cubicle.

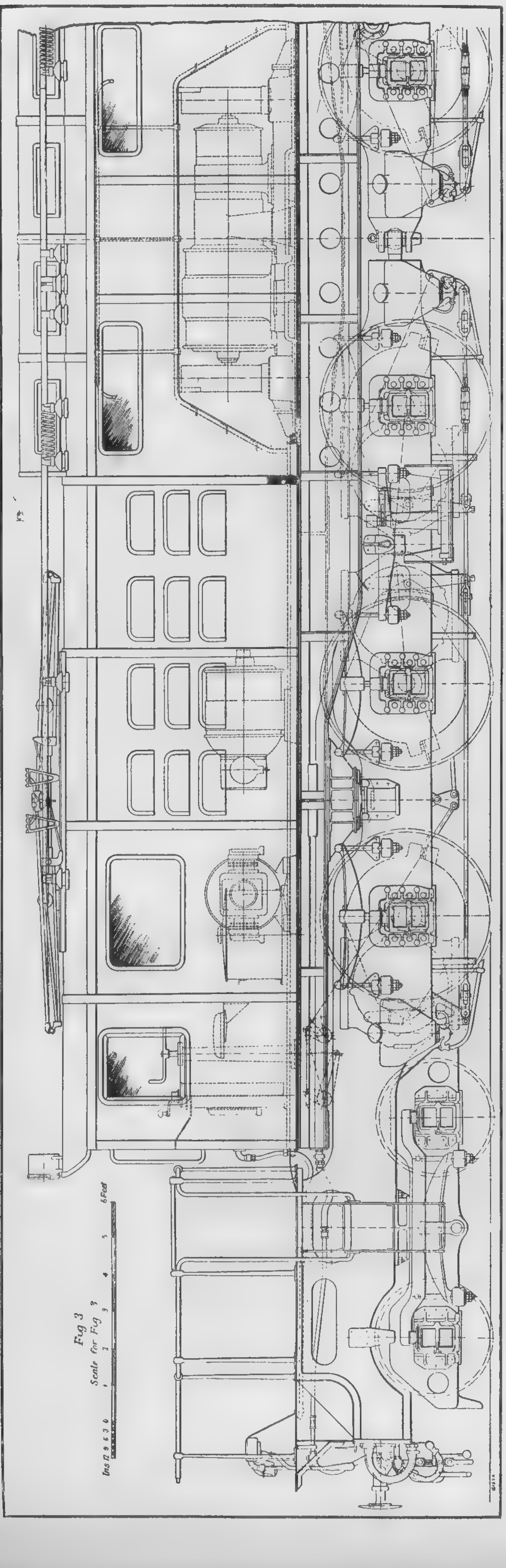


Interior of Yaguchi Power Station of the Imperial Government Railway, showing Two of Four Sets of Dick Kerr (English Electric Co.) Alternators, 1,500 K.V.A. each, 3 phase, 25 cycles, 11,000 volts, driven by Lilleshall Gas Engines

The A.C. and D.C. switchboards are arranged in a gallery overlooking the rotary converters, a view of the latter board being illustrated on page 417.

As will be seen, the D.C. switchboard consists of 14 panels in all, *viz.* four rotary, one negative isolating, one total output and eight 2,000 k.w. feeder panels. A point of particular interest is that all the instruments are mounted on porcelain insulators behind each panel, being viewed through holes cut in same.

The isolating switches and circuit-breakers are remote mechanically controlled, the latter being of the magnetic blow-out type and mounted well behind each control panel.



Half Section of 1,800 H.P. 4-6-6-4 Type English Electric Locomotive for the Imperial Japanese Railways

Past experience has shown that it is policy to house important electrical apparatus in earthquake-proof buildings as far as it is possible to do so, and the Kawasaki sub-station has been constructed throughout on exceedingly strong lines. Economy has not been overlooked, inasmuch as old disued track rails have been utilised for the switch gallery and other interior structural work, as can be clearly seen from the views contained herein.

Kanagawa : Capacity, 8,000 k.w. ; receiving voltage, 11,000, 50 cycles. This station has eight 1,000 k.w. 6-phase compound rotary converters, 750 r.p.m., delivering direct current at 750 volts. The transformers, four in number, are of 2,100 k.v.a. 3-phase delta connected in the primary and 6-phase diametrical connections in the secondary winding. The primary voltages are 11,000, 10,500 and 10,000, with 530 volts in the secondary. In addition, automatic switching apparatus is installed and all the equipment is from the Westinghouse Electric International Company.

Ofuna : Capacity, 8,000 k.w.; receiving voltage, 66,000, 50 cycles. This station has four 2,000 k.w. Bruce, Peebles motor converters and four 2,500 k.v.a. Mitsubishi Electric and Manufacturing Company transformers, three-phase delta connected in the primary and six-phase délta connected in the secondary winding. The primary voltage is 66,000, and 6,600 in the secondary. This station was also completed in April 1925.

Oimachi: The old station capacity is 6,000 k.w., receiving voltage 11,000, 50 cycles, equipped with six Shibaura 1,000 k.w. six-phase compound wound rotary converters operating at 750 r.p.m., delivering current at 600 volts and insulated for 1,200. The new Oimachi station's capacity is 4,000 k.w., receiving voltage 11,000, 50 cycles, equipped with four 1,000 k.w. six-phase compound wound Westinghouse rotary converters operating at 750 r.p.m., and delivering current at 750 volts, insulated for 1,500 volts into two 2,100 k.v.a. transformers, three-phase delta connected in the primary and six-phase diametric in the secondary, with Westinghouse automatic switching equipment. Six 800 k.w. Brown-Boveri mercury rectifiers will also be installed in this station.

Shiodome : This station is to be located near the main terminal of the railway in Tokyo. Capacity, 8,000 k.w.,; receiving voltage, 11,000/22,000, 50 cycles. It will be equipped with eight Westinghouse 1,000 k.w. synchronous converters shunt wound, 750 r.p.m., delivering current at 750 volts, with four 2,100 k.v.a. transformers, three-phase delta connected in the primary and six-phase diametric in the secondary. This station will have Westinghouse automatic switching equipment, and later increased to a total of 12,000 k.w.

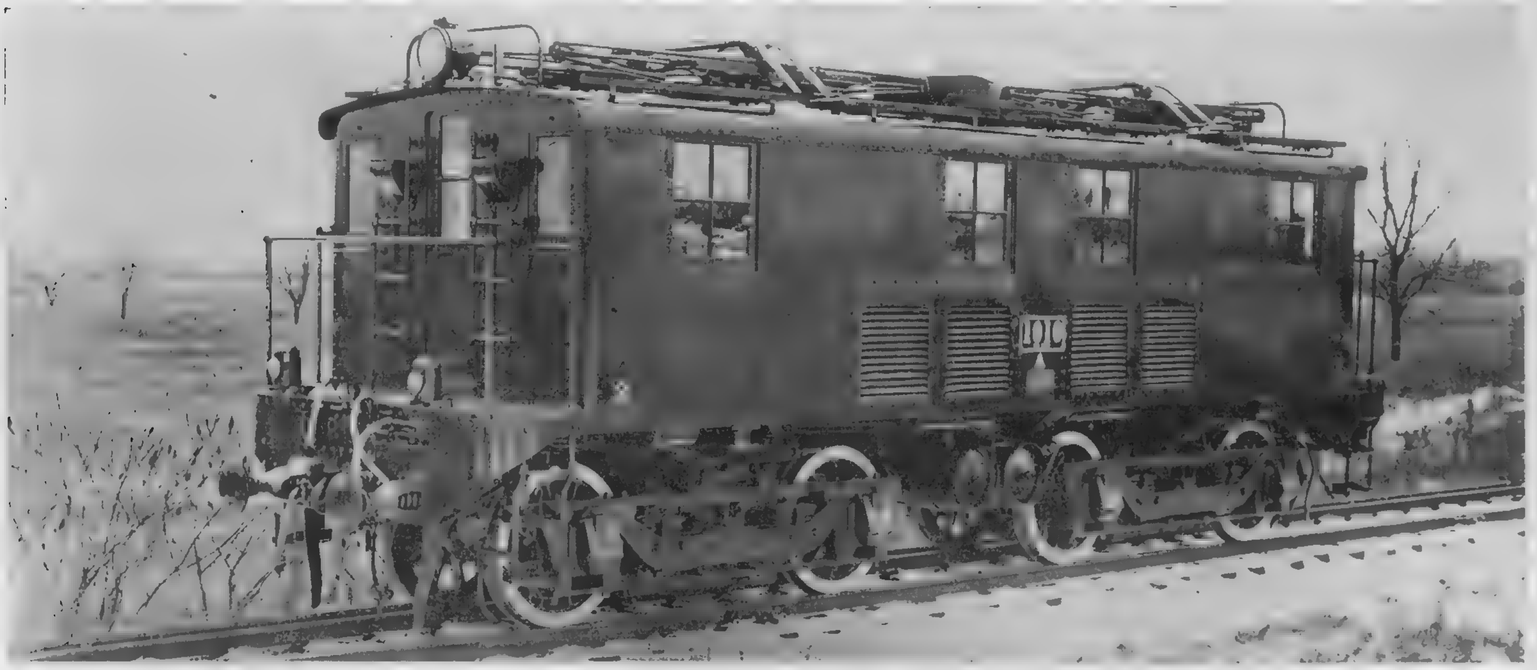
Iidamachi and Uyeno : Capacity of each of these stations is 6,000 k.w., equipped the same as the Shiodome station. Iidamachi is, however, unusual, in that it is designed to operate automatically at a trolley voltage of 600, 1,200 or 1,500 volts D.C.

Yugawara : This is the last station at the end of the present electrified line beyond Odawara. The capacity is 4,000 k.w.; receiving voltage, 66,000, 50 cycle. Two Westinghouse 2,000 k.w., 375 r.p.m. synchronous motor generating sets, generating 1,500 volts D.C. on a single commutator, will be installed. Also two 2,500 k.v.a. three-phase transformers step the supply voltage of 66,000 down to 2,300 for the motor of the motor generator set. Automatic Westinghouse switching equipment will control this station, and provision is made to handle regeneration from the locomotives operating on the heavy grade on which this station is located.

Ninomiya : Capacity, 6,000 k.w.; receiving voltage, 66,000, 50 cycles. The equipment is a duplicate of the Ofuna station and was completed in April last.

Automatic switching equipment has been installed in six of these new sub-stations in order to insure the continuity of service which is so essential to the successful operation of an electric railway. These installations represent the largest concentration of power in single sub-stations under automatic control in the world and their operation will be watched by electrical engineers from all countries.

Sub-station	No.	No. Mach.	Cap. Ea. k.w.	Type Switching	Max. Oper. Volt.
Yeirakucho ..	1	6	1,000	Hand.	1,200
Kanda	2	1	1,000	Hand.	600
Tabata	3	3	1,000	Hand.	1,200
Okubo ..	4	3	1,000	Hand.	600
		4	1,000	Hand.	1,200
Kichijoji ..	5	2	500	Hand.	600



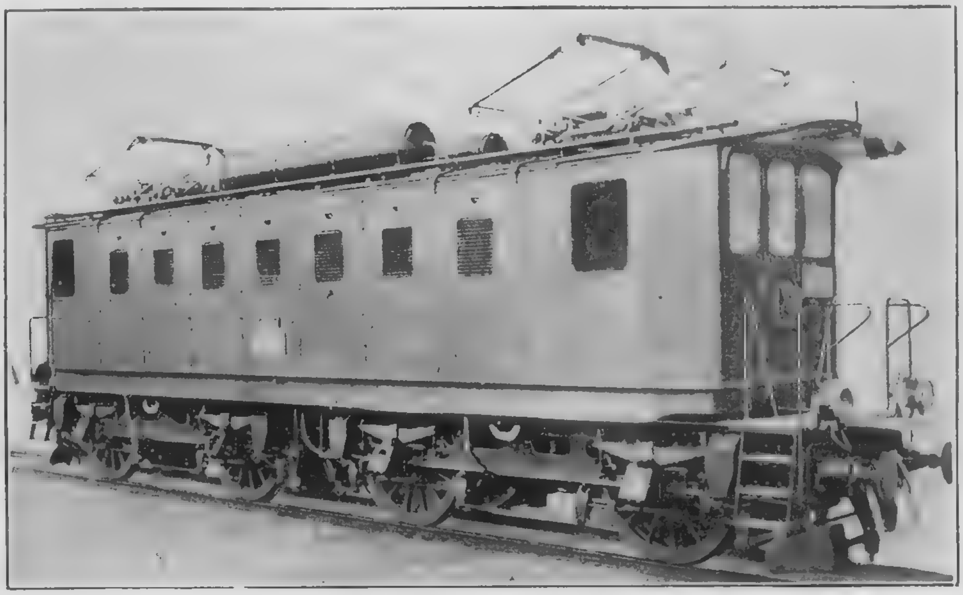
General Electric 600-1500 volt Locomotive for Imperial Japanese Railways

Sub-station	No.	No. Mach. Name	Cap. Ea. k.w.	Type Switch-ing	Max. Oper. Volt.
Oimachi..	6	6	1,000	Hand.	1,200
		4	1,000	Auto.	1,500
Kawasaki	7	6	1,000	Hand.	1,500
Kanagawa	8	8	1,000	Auto.	1,500
Shiodome	9	8	1,000	Auto.	1,500
Uyeno ..	10	6	1,000	Auto.	1,500
Iidamachi	11	6	1,000	Auto.	1,500
Ofuna ..	12	3	2,000	Hand.	1,500
Ninomiya	13	2	2,000	Hand.	1,500
Yugawara	14	2	2,000	Auto,	1,500

Connections between sub-stations is by overhead line or underground cable. For the Kawasaki-Ofuna-Ninomiya and the Kawasaki-Kanagawa sections, 66,000 and 11,000 volt overhead transmission lines are used, while a 22,000 volt underground cable connects the Kawasaki and Oimachi sub-stations. From the Akabane power station power is transmitted to Kawasaki sub-station by means of an overhead 66,000-volt line.

Trolley wire suspension is of the compound catenary system carrying a conductor of B.S4/0 grooved hard-drawn copper wire. The messenger wire is a steel cable 7 BWG No. 6 and the auxiliary messenger is a hard-drawn copper cable 19 B.S. No. 10. The side line is a single catenary system with 7/BWG No. 8 standard steel wire for messenger service.

Iron towers, spaced 80 metres apart, are in general use on the Tokyo-Yokohama and the Yokosuka sections, while on the other sections, wooden poles, spaced 40 metres apart, will be used on straight sections, with shorter distances on curves and straining points. The main line rails are double bonded with B 5-4/0 stranded copper wire.

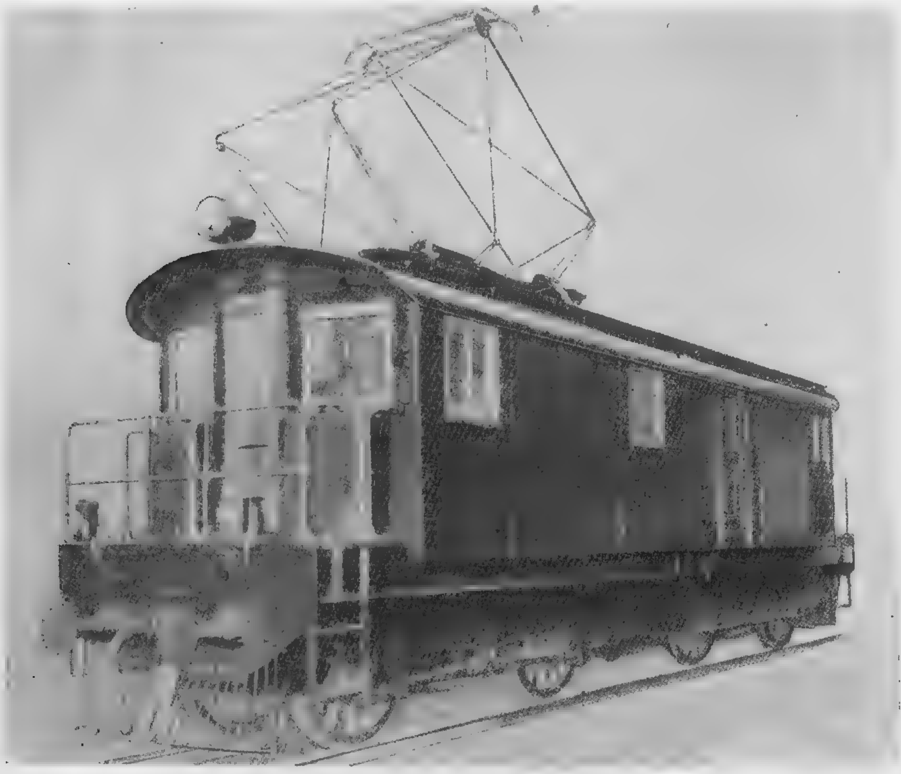


One of two 1,380 H.P., 1,500 volt Brown-Boveri Electric Freight Locomotives for the Imperial Japanese Railways

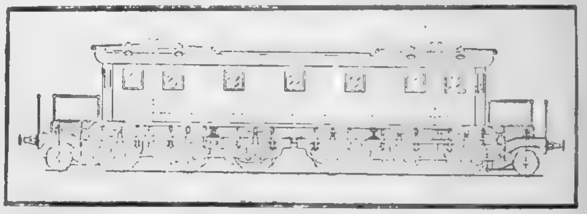
Fifty-six locomotives have been ordered from various makers for the service of the electrified sections and are to be placed in operation as soon as the new equipment is installed. Delivery of fourteen of these locomotives has been postponed until next year in order to meet the wishes of the Railway Board, whose appropriation was cut in order to carry out the present year's retrenchment program. In addition to the fifty-six locomotives actually ordered by the Railway Board, the Metropolitan Vickers Company of England have two locomotives in Japan awaiting trials for acceptance. The Hidachi Engineering Works, controlled by the Kuhara interests, one of the leading Japanese manufacturers of electrical machinery, has also turned out at their own shops two locomotives that passed successfully trial running tests, and have been accepted by the railway authorities. This gives a total of 60 new electri locomotives ordered and available for carrying out the new electrification program. The Railway Board also owns 343 motor coaches and 265 trailer cars. The details of the fifty-six locomotives are given in the table at the end of this article.

Supplementing the present electrified sections between Tokyo and Odawara is the still more pretentious scheme, which received the approval of the Imperial Diet, extending the system to the main Tokaido. Line from Odawara to Akashi, the other side of Kobe. The lines approved by the Diet are:

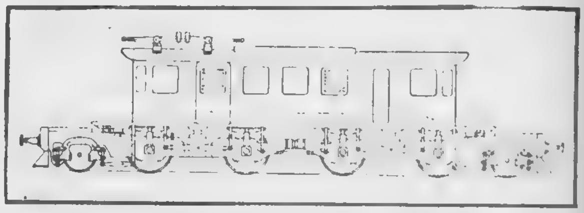
Odawara-Akashi	326.2	miles	(double track)
Uyeno-Omiya	16.6	,,	(four track)
Uyeno-Kanda	1.5	,,	,, ,,
Kokubunji-Hachioji	9.9	,,	double track
Manseibashi-Ryogokubashi	1.7	,,	,, ,,
Ryogokubashi-Chiba	22.7	,,	,, ,,
Joto Line (Osaka-Minatomachi) ..	8.9	,,	,, ,,
Katamachi Line (Katamachi-Shijonawate)	8.2	,,	single track



Two 60.5-ton Baldwin-Westinghouse Locomotives for the Imperial Japanese Railways



Two 105-ton, 1,500 volt D.C. Baldwin-Westinghouse Passenger Locomotives for the I.J.R.



Six 75-ton 1,500 volt D.C. Baldwin-Westinghouse Passenger Locomotives for the I.J.R.

Investigations and surveys are being carried out with the view of electrifying a further 3,000 miles of government railways, creating a network that will cover the main island. The execution of this plan will, however, be indefinitely postponed until the waterpower resources are developed to the point where ample power will be guaranteed at all seasons of the year.

General Electric Freight Locomotives for the Imperial Government Railways

The last order received by the General Electric Company (U.S.A.) for electric locomotives for the Imperial Government Railways of Japan covers four freight locomotives, similar in many respects to the two delivered in 1923 which have successfully passed the tests made by the engineers of the I. G. R. These new locoomtives are now being built in the Erie Works of the General Electric Company, and will be completed, tested, and shipped about December first of this year.

The principal data of these units are as follows :

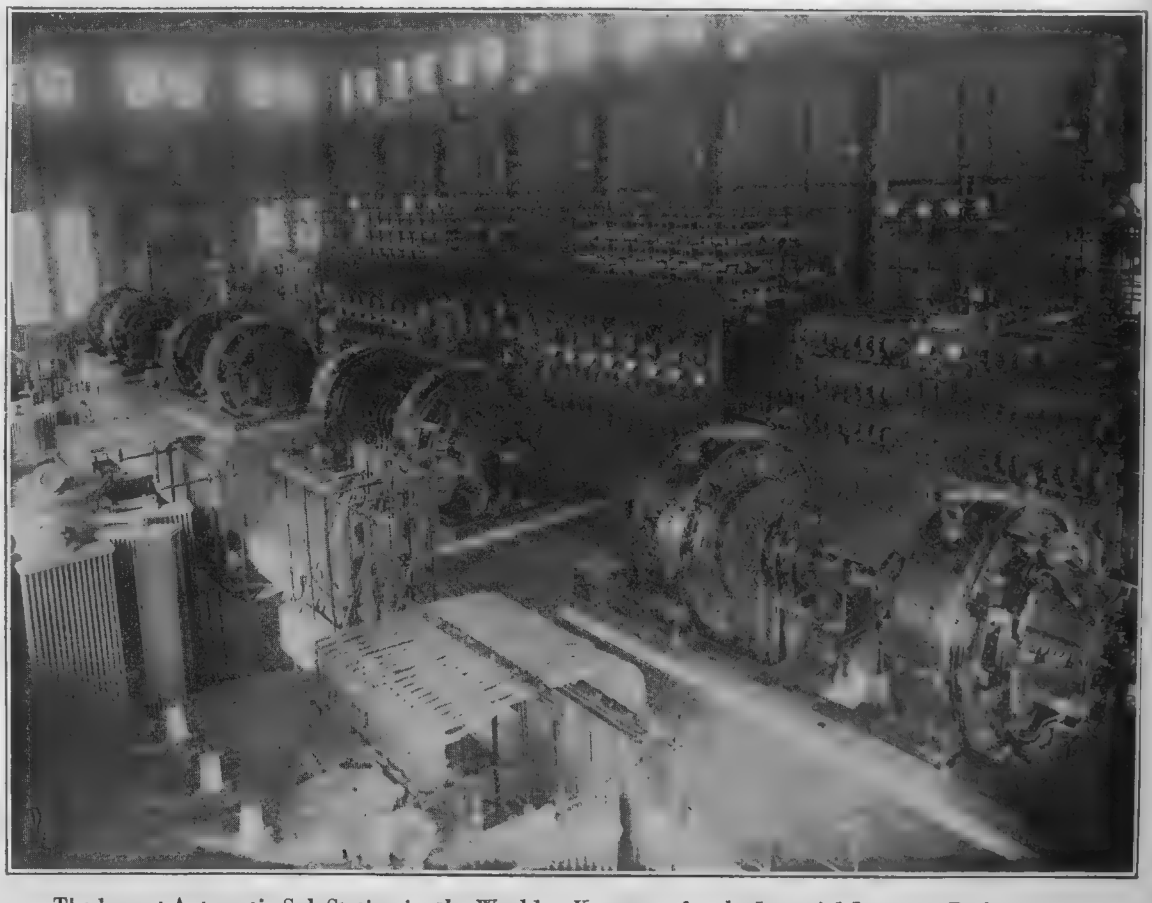
Trolley voltage ..	1,500 volts
Track gauge ..	1,067 m.m.
Length over cab	8,839 m.m.
Rigid wheel base	2,641 m.m.
Height over pantograph retracted	3,910 m.m.
Total weight, all on drivers ..	60,000 kg.
Type	0-4-4-0

The locomotives have two two-axle aticulated trucks, with one geared motor for each axle and a single cab carried on center plates on the trucks. The tractive effort available for 6½ minutes based on 30 per cent. adhesion is 18,000 kg.; with full field, and 1,500 volts at the trolley; a tractive effort of 7,100 kg. at a speed of 39.7 km. per hour will be obtained continuously with blowers operating under the same conditions; with 1,350 volts on the trolley, 7,100 kg. tractive effort will be obtained at a speed of 35.7 miles per hour.

Provision has been made for field tapping so that higher speeds may be obtained on straight level track. With 52 per cent. field strength the continuous blown rating, with 1,500 volts trolley potential, is 7,320 kg. tractive effort at 48 km. per hour.

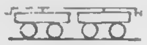
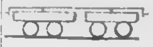
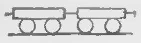
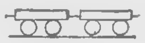
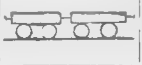
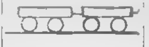
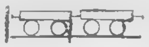
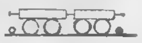
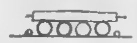
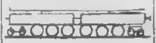
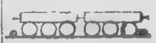
The maximum safe speed limited by the construction of the locomotive is 75 km. per hour, but since the limiting speed for freight trains is considerably below this, ample margin has been provided.

There are four traction motors of the geared type, rated GEZ-1234-750/1,500 volts on each locomotive. This is a form of the GE-274-A motor, which was so successfully applied to the first locomotives furnished, with the field windings re-designed. The motors are spring nose suspended, and drive the axle through a single

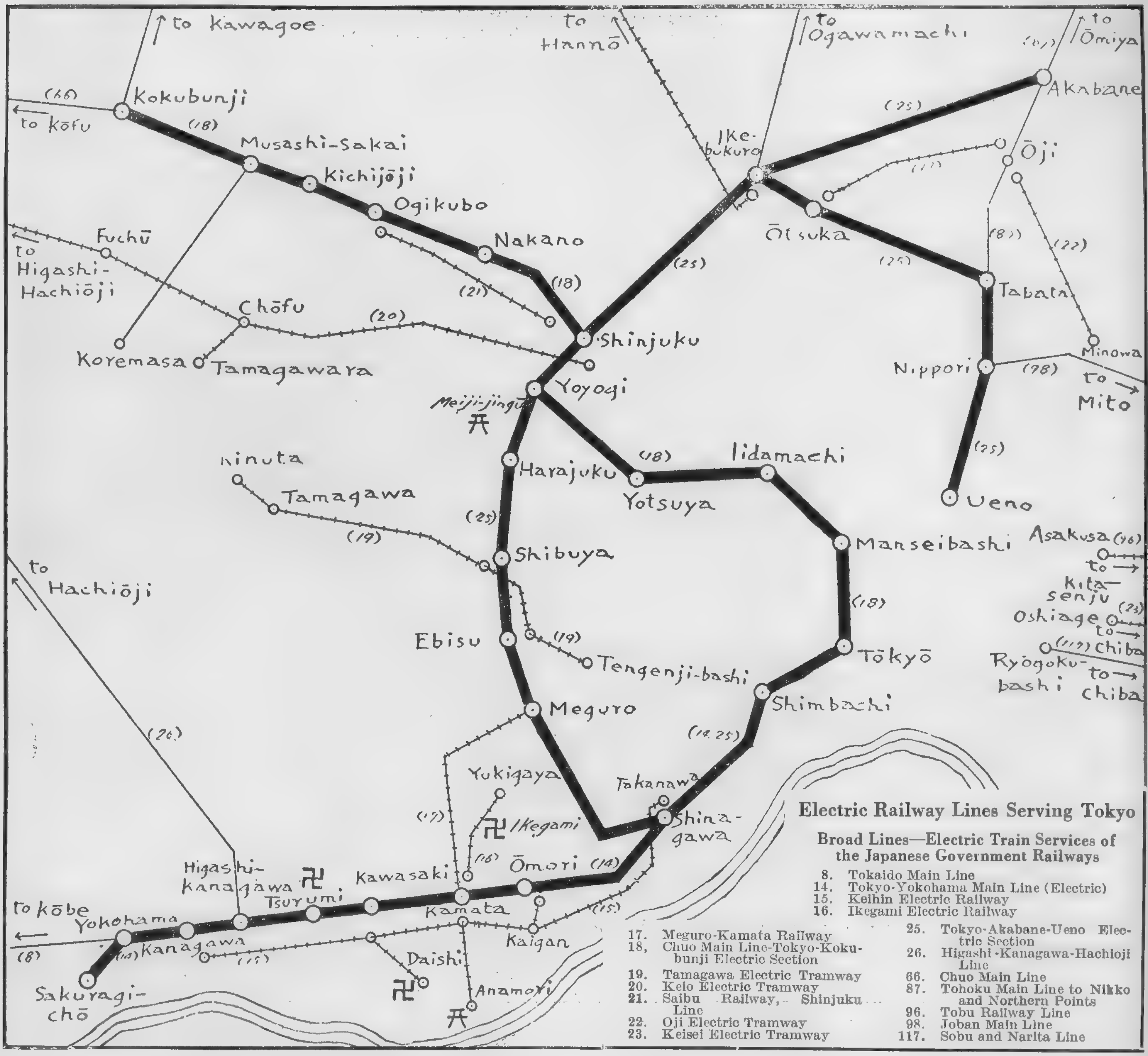


The largest Automatic Sub-Station in the World at Kanagawa for the Imperial Japanese Railways; total capacity 8,000 k.w., containing four Westinghouse 2,000 k.w., 1.500 volt d.c. Synchronous Converter Units.

ELECTRIC LOCOMOTIVE DATA, JAPANESE GOVERNMENT RAILWAYS

TYPE	1000	1010	1020	1030	1040	*1060	6000	*6010	*7000	8000	*8010
Number	2	2	2	2	17	4	9	6	2	8	2
Service	Freight	Freight	Freight	Freight	Freight	Freight	Passenger	Passenger	Express passenger	Express passenger	Express passenger
Voltage	750v/1500v, 600v/1200v	750v/1500v, 600v/1200v	750v/1500v, 600v/1200v	750v/1500v, 600v/1200v	1500v	1500v	1500v	1500v	1500v	1500v	1500v
Maker: Mechanical part	Baldwin Loco. Works	G. E. Co.	Schlieren A.G.	Preston Works	North British Loco. Co.	G. E. Co.	North British Loco. Co.	Baldwin Loco. Works	Swiss Loco Co..	North British Loco. Co.	Baldwin Loco. Works
Maker: Electrical part	Westinghouse El. & Mfg. Co.	G. E. Co.	Brown Boveri Co.	English El. Co.	English El. Co.	G. E. Co.	English El. Co.	Westinghouse El. & Mfg. Co.	Brown Boveri Co.	English El. Co.	Westinghouse El. & Mfg. Co.
Gauge (m.m.)	1,067	1,067	1,067	1,067	1,067	1,067	1,067	1,067	1,067	1,067	1,067
No. of driver's compartment	2	2	2	2	2	2	2	2	2	2	2
Length (m.m.): Total, over buffers	12,368	11,345	13,248	12,420	12,420	10,978	12,420	12,497	13,200	21,209	16,561
Length (m.m.): Cab	9,754	8,839	10,850	11,582	11,582	8,839	11,582	9,754	—	15,240	11,582
Width (m.m.): Overall, including grab handles	2,857	2,850	—	2,800	2,800	2,740	2,800	2,794	—	2,800	2,794
Width (m.m.): Cab	2,794	2,820	2,744	2,590	2,610	—	2,610	2,765	—	2,591	2,765
Height above rail (m.m.): Top of cab	3,655	3,471	3,675	3,706	3,586	3,467	3,586	3,435	3,475	3,581	3,435
Height above rail (m.m.): Pantograph up	5,200	6,100	6,240	6,146	6,285	—	6,285	—	—	6,285	—
Height above rail (m.m.): Pantograph stowed	4,100	3,920	4,235	4,035	3,910	3,910	3,910	4,055	3,900	3,935	4,055
Wheel base (m.m.): Rigid	2,769	2,590	3,150	2,820	2,820	2,641	2,820	2,032	1,900	4,267	4,064
Wheel base (m.m.): Total	8,941	7,924	9,200	8,610	8,610	7,516	8,610	6,401	9,300	18,364	10,459
Distance between bogie centres (m.m.)	6,172	5,334	6,050	5,790	5,790	5,055	5,790	5,436	—	9,411	—
Wheel dia. (m.m.): Driving	1,245	1,067	1,400	1,245	1,245	1,245	1,245	1,245	1,600	1,400	1,245
Wheel dia. (m.m.): Leading	—	—	—	—	—	—	—	838	939	940	762
Construction of trucks	Bar frame with equalizer	Steel frame with equalizer	Steel frame without equal.	Plate frame	Plate frame	Plate frame	Plate frame	Bar frame	Plate frame	Plate frame	Bar frame
Connection of trucks	Non-articulated	Non-articulated	Articulated	Articulated	Articulated	Articulated	Articulated	Articulated	—	Articulated	Articulated
Weight (metric ton): Total	56.48	59.6	59.22	60.4	58.32	60	57.97	69.42	76	97	93
Weight (metric ton): Mechanical part	34.6	37.4	32	—	—	35.5	—	46.6	47	—	61.8
Weight (metric ton): Electrical equipment	21.88	22.2	27.22	—	—	24.5	—	22.82	29	—	31.2
Weight (metric ton): On driving axle	14.1	14.9	14.8	15.1	14.6	15	14.5	12.9	14.5	12	12.7
Weight (metric ton): On leading axle	—	—	—	—	—	—	—	8.9	9	6.25	8.5
Weight (metric ton): Adhesive	56.48	59.6	59.22	60.4	5,832	60	57.97	51.6	58	72	75.9
Number of motors	4	4	4	4	4	4	4	4	4	6	6
Type of motor	Delta 2726	G.E.-274-A	G.D.T.M. 75/6.22	D.K.-86-A	D.K.-86-A	G.E.-274-A	D.K.-86-A	352-K-5	G.L.M. 75/6.28	D.K.-86-A	@ 352-K-5
Voltage of motor	750v	750v	750v	750v	750v	750v	750v	750v	750v	750v	750v
*One hour rating of motor: Voltage (v)	750	750	540	540	675	750	675	750	750	675	750
*One hour rating of motor: Current (a)	282	290	375	350	350	290	350	340	610	350	340
*One hour rating of motor: R. P. M.	625	765	270	500	630	934	630	630	830	630	630
*One hour rating of motor: Output (h)	250	260	235	220	275	265	275	300	550	275	300
Speed (KM/H): *One hour rating	33.2	35.4	25	29	50	50.7	59	55.5	80	66.5	55.5
Speed (KM/H): Max. safe	65	65	65	65	65	75	85	100	110	96	110
Tractive effort (kg.): *One hour rating	7,840	8,050	10,000	8,350	6,100	5,400	5,100	6,000	7,820	6,940	9,000
Tractive effort (kg.): Max. (20% adhesion)	14,100	14,900	14,800	15,100	14,600	15,000	14,500	12,900	14,500	18,000	19,000
System of power transmission	Single reduction gear	Single reduction gear	Twin single reduction gear	Single reduction gear	Single reduction gear	Single reduction gear	Single reduction gear	Flexible single reduction gear	Individual axle drive. Single reduction gear	Single reduction gear	Flexible single reduction gear
Gearing: Type	Helical stub	Spur	Helical	Spur	Spur	Spur	Spur	Spur	—	Spur	Spur
Gearing: Diametral pitch	2	2.5	2	2	2	2.5	2	2	—	2	2
Gearing: Gear ratio	16:72	19:82	23:90	18:73	23:68	19:82	26:65	24:64	41:138	26:65	24:64
System of control	Unit switch Type H.L.F.	Unit switch Type P.C.L.	Motor-operated cam shaft	Motor-operated cam shaft	Motor-operated cam shaft	Unit switch. Type P.C.L.	Motor-operated cam shaft	Unit switch. Type H.B.F.	Motor-operated cam shaft	Motor-operated cam shaft	Unit switch. Type H.B.F.
Control circuit: Source	Dynamotor	Dynamotor	Motor-gen.	Motor-gen.	Motor-gen.	Motor-gen.	Motor-gen.	Motor-gen.	Motor-gen.	Motor-gen.	Motor-gen.
Control circuit: Voltage	600	600	110	100	100	100	100	32	100	100	32
Brake equipment	Westinghouse El. 14 air brake, and hand brake.	Westinghouse El. 14 air brake, and hand brake.	Westinghouse El. 14 air brake, and hand brake.	Westinghouse El. 14 air brake, and hand brake.	Westinghouse El. 14 air brake, and hand brake	Westinghouse El. 14 air brake, and hand brake	Westinghouse combined air and vacuum brake, and hand brake	Westinghouse combined air and vacuum brake, and hand brake	Westinghouse combined air and vacuum brake, and hand brake	Westinghouse combined air and vacuum brake, and hand brake	Westinghouse combined air and vacuum brake, and hand brake
Wheel arrangement											

Remarks : * Based on short-field connections. ‡ Locomotives recently ordered.



Electric Railway Lines Serving Tokyo

Broad Lines—Electric Train Services of the Japanese Government Railways

8.	Tokaido Main Line
14.	Tokyo-Yokohama Main Line (Electric)
15.	Keihin Electric Railway
16.	Ikegami Electric Railway
17.	Meguro-Kamata Railway
18,	Chuo Main Line-Tokyo-Kokubunji Electric Section
19.	Tamagawa Electric Tramway
20.	Keio Electric Tramway
21.	Saibu Railway, Shinjuku Line
22.	Oji Electric Tramway
23.	Keisei Electric Tramway
25.	Tokyo-Akabane-Ueno Electric Section
26.	Higashi -Kanagawa-Hachioji Line
66.	Chuo Main Line
87.	Tohoku Main Line to Nikko and Northern Points
96.	Tobu Railway Line
98.	Joban Main Line
117.	Sobu and Narita Line

solid gear. The ventilation is accomplished by means of two external blowers, driven by 1,500 volt motors located in the cab, which supply air through suitable ducts to a large opening in each motor frame near the commutator end. Here the air divides in two paths, one of which is over the armature and around the field coils, and the other under the commutator and through the longitudinal holes in the armature core. Openings are provided in the pinion end of the frame through which the air is expelled.

The locomotives are equipped with PCL multiple unit non-automatic control. There is a master controller in each end of the locomotive, having ten steps with all four motors in series, eight steps with two motors in series, the two groups in parallel with full field, and two steps with this series parallel grouping of motors and shunted field. The tenth and eighteenth are running steps with all the accelerating resistance short circuited.

There are 22 electro pneumatic conectors which close and open the motor and resistance circuits in the proper sequence to obtain smooth acceleration of the locomotive. They are also used to commutate the motor circuits from one motor combination to another. The contact unit is closed by air pressure controlled by a magnetically operated valve and opened by a strong spring against which it is closed.

The reverser controlling the direction of rotation of the motors is electro-pneumatically operated and consists of a series of cylindrical castings mounted on an insulated shaft. The contacts are made by fingers mounted along the cylinder on insulated rods. It is interlocked with the line contactors so that they cannot close until the position of the reverser corresponds to the position of the reverse handle on the master controller.

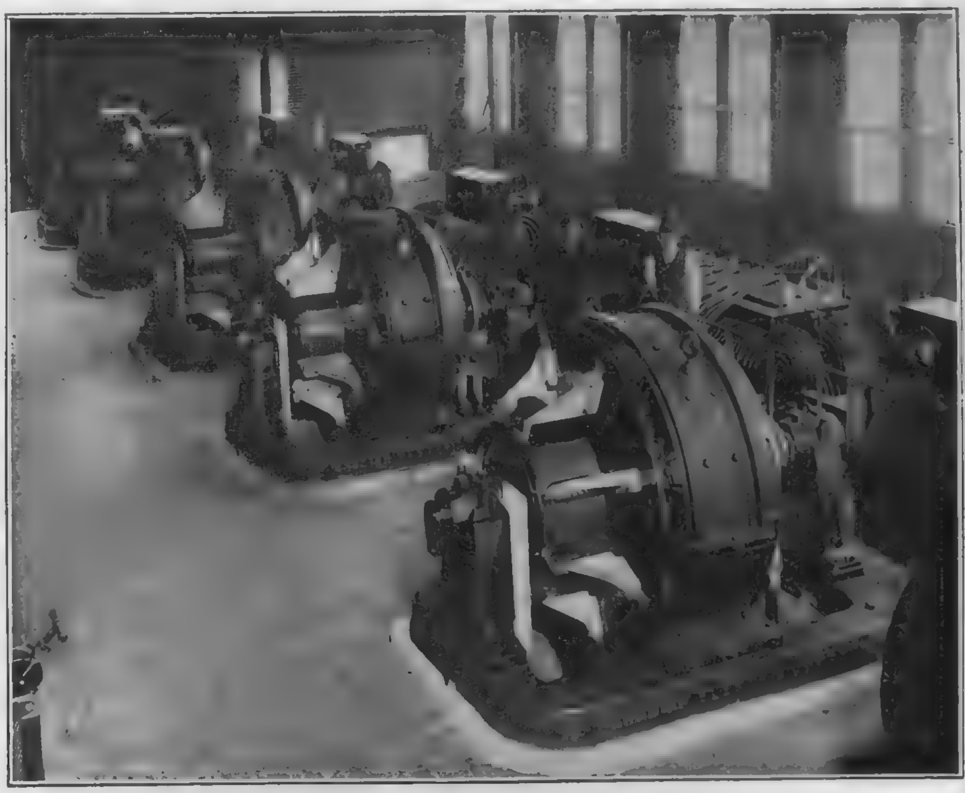
The main switch is hand-operated and carries the entire locomotive current. It also serves as a disconnecting switch during inspection. By means of knife blade switches, one pair of motors may be cut out of the circuit in case of emergency. Suitable interlocks on these switches commutate the control circuits so that the locomotive may be operated with the remaining motors.

Power for the control circuit is obtained from a motor generator set rated GEZ-2,049-750/1,500-100 volts. For control operation a potential above 50 volts is preferred, due to the fact that a lower voltage may not be able to send sufficient current through contact surfaces that have become slightly dirty.

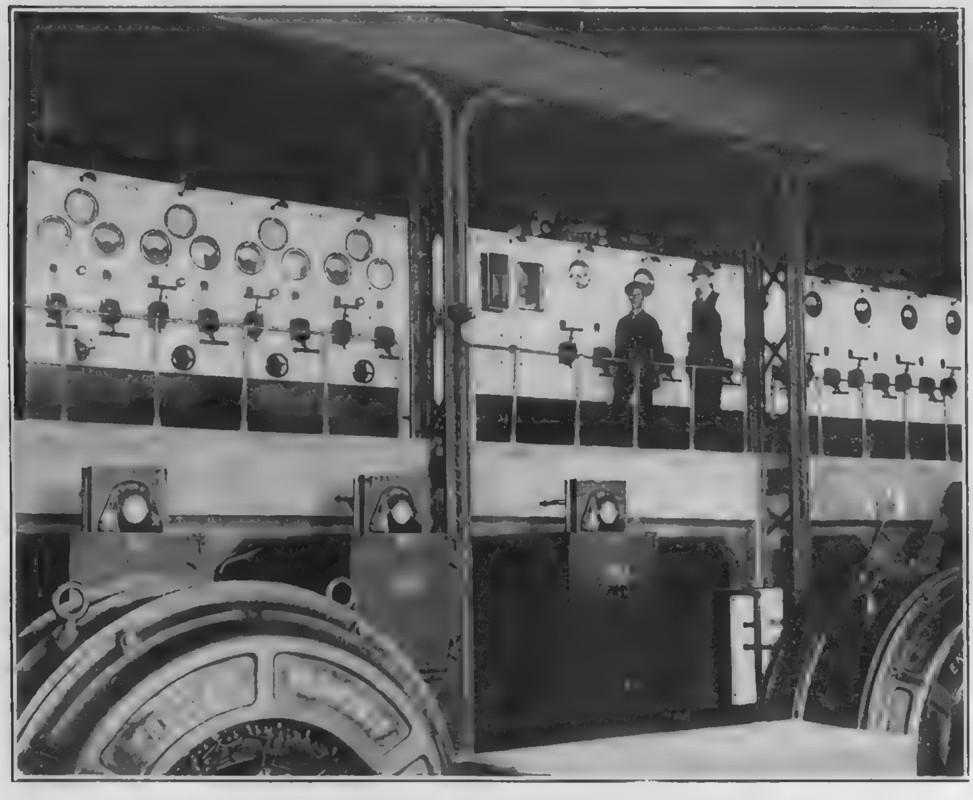
The voltage output of this set is held approximately constant at 100 volts by means of a General Electric type TD regulator over a trolley potential range from 1,500 volts down to 1,100 volts with full output, and down to 1,000 volts with reduced output sufficient to operate the control and lights. Below 1,000 volts trolley potential the power for control and lights is furnished by a storage battery automatically. This consists of 45 Edison cells type DMT-3, which has sufficient capacity to keep all lights and the headlight lighted for 4 hours.

Each locomotive is equipped with two pantographs similar to those used on the Chicago-Milwaukee-St. Paul Railway, the Paulista and others. In tests conducted at the Erie Works of the General Electric Company a single pantograph of this design has shown its ability to collect 5,000 ampères from a suitably suspended trolley wire at a speed of 100 km. per hour.

The pantograph is raised by air pressure controlled by magnet valves and has an operating range of 2,030 mm. The contact surface of the pantograph consists of two steel pans provided with copper wearing strips which are easily renewed. The contacts are held at practically constant pressure against the trolley wire by means of cams and springs which are held in tension by the air cylinders.



Kawasaki Sub-Station; Part View of English Electric Rotary Converters and Starters



Kawasaki Sub-Station: English Electric 1,500 volt D.C. Switchboard

For protection against short circuits or sudden overload type JR high speed circuit breaker of suitable capacity is provided, connected in the circuit directly after the main switch. The advantage which this breaker possesses over others is the elimination of any mechanical latches for tripping. This enables it to stop a current rush in approximately .008 seconds. The Imperial Government Railways have ordered over 50 of this type of high-speed breaker for the protection of sub-station apparatus.

An overload relay provides for overload protection of the motors. When the motor current exceeds a certain predetermined value the relay contacts open up the line and resistance contactors. Operation can be resumed by returning the master controller to the first point.

Each truck of the running gear has side frames of steel plate securely bolted to two end transoms and a middle transom. These are of cast steel and suitably designed for the attachment of the side plates, draft gear, and draw head of the articulation. The middle transom, which is hollow, supports a hollow center plate and is designed with suitable strength to carry the various tressess and to conduct the air from the air duct in the platform down to the traction motors.

Semi-elliptic leaf springs, proportioned to the weight to be carried, support all parts except the wheels, axles, journal boxes and about one-half the motor weight.

The braking of the locomotive is accomplished by means of Westinghouse type EL-14 air brake equipment and a hand brake. Two General Electric CP-30-1,500 volt single stage air compressors are provided on each locomotive. They are automatically controlled by a pressure governor switch.

The box type cab is divided into apparatus and drivers compartments, which will be arranged in a similar manner to those of the previous locomotives. The master controller will be at the left of the cab in accordance with the practice of the Imperial Government Railways.

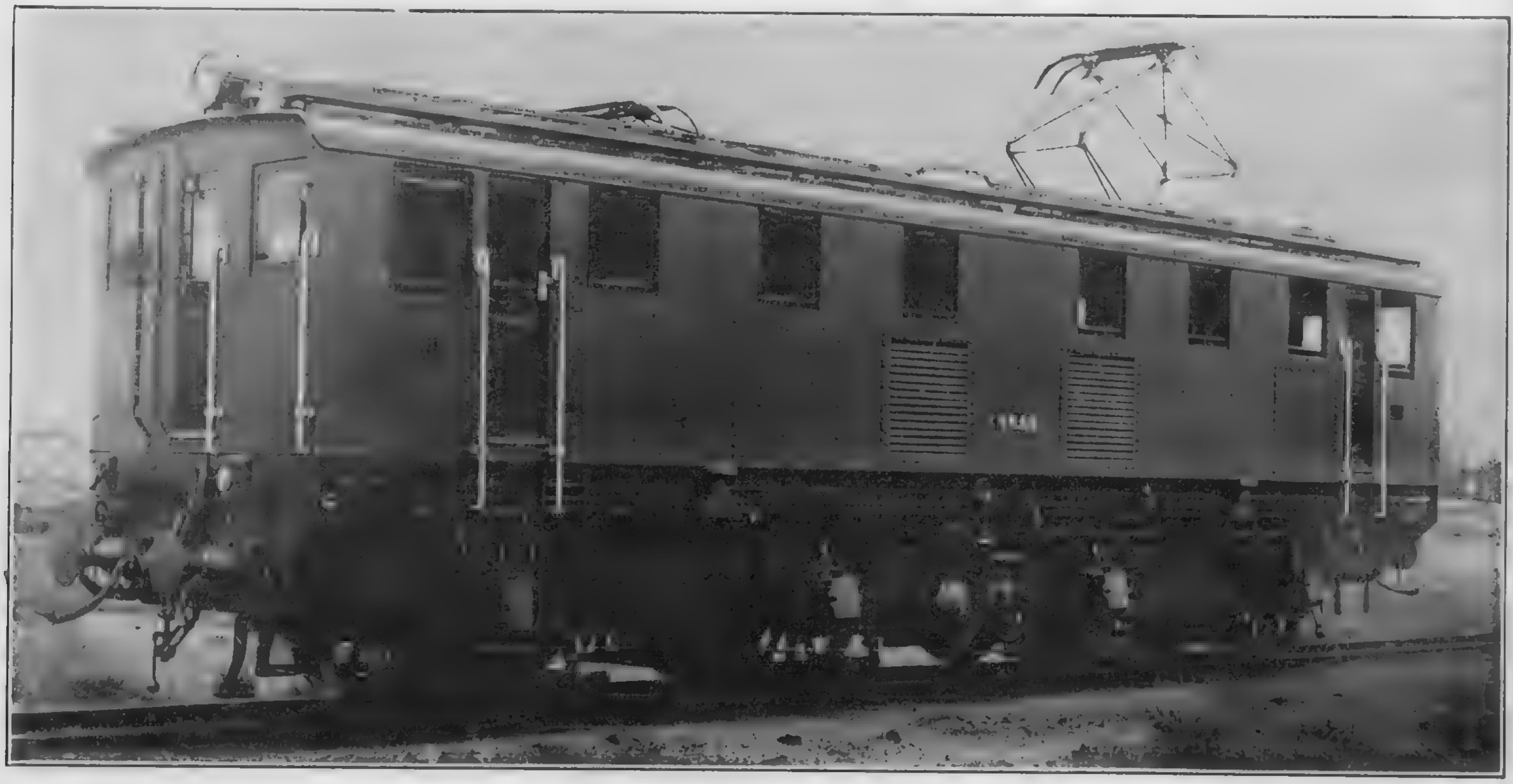
English Electric Locomotives

Eight of the locomotives from the English Electric Company are of the 4-6-4-4 type and the remaining 28 of the 0-4-4-0 type and have motor equipment of 1,200 h.p. The larger locomotives, the mechanical parts of which were made by the North British Locomotive Company, are to be employed in express passenger service. When first they are put into operation they will take trains from Tokyo to Kozu, a distance of some 50 miles, stopping about half-way at Yokohama. Eventually, however, they will run to Odawara over the new direct route to Numazu, 80 miles from Tokyo and about 4 miles beyond Mishima, the connecting point between the new line and the original main line.

As the gauge of the lines over which the locomotive works is 3-ft. 6-in., and as the service demanded required a high power, amounting to 1,800 h.p. at the one-hour rating, the question of the motor arrangement and drive required much consideration.

The conditions imposed by the narrow gauge operated in the direction of limiting the size of motor which could be carried between the frames, and accordingly six motors were adopted. These are each of 306 h.p. on one-hour rating. The line pressure is 1,500 volts direct current, and the motors are of 750 volts each and are run two permanently in series. A gear drive is used, and the arrangement follows closely that commonly utilized in connexion with multiple-unit passenger coaches.

The under-frame is carried on two trucks, each equippe dwith three driving axles and one swivelling bogie. The driving wheels are 4-ft. 7-in. in diameter, and the driving axles are each driven independently by a motor. The total weight of the locomotive is 100 tons, there being about 12 tons on each driving axle and 7 tons on each axle of the leading and trailing bogies. Compensation is provided between two axles only on each truck. As will be clear, the wheel arrangement of the locomotive is symmetrical about the centre line. The control of the locomotive is carried out on the English Electric Company's camshaft system. The electrical arrangements consist, briefly, of a main camshaft controller, and is operated by an electric motor which is controlled by a master controller. The camshaft controller handles the main 1,500-volt current, regulating the amount of resistance in the motor circuits and determining the grouping of the motors. It consists of a series of steel cams mounted on a mica-insulated steel shaft. The electric motor drives the shaft through a flexible drive and worm gear, and as the cams are set at different angles, each in turn closes a contactor, the contactors regulating the amount of starting resistance in the main circuit and determining the grouping of the motors. The order of operation of the contactors is determined by a purely mechanical arrangement, so that it is impossible for them to close in the wrong order and no interlocking arrangement is required. An interlock is, however, provided on the line switches, so that the camshaft cannot begin to rotate in a forward direction until the line switches have closed, not in a backward direction until they have opened. The main current is consequently always made and broken on the line switches only, and the camshaft contactors require neither blow-outs nor arc shields.



A Japanese-built Electric Locomotive

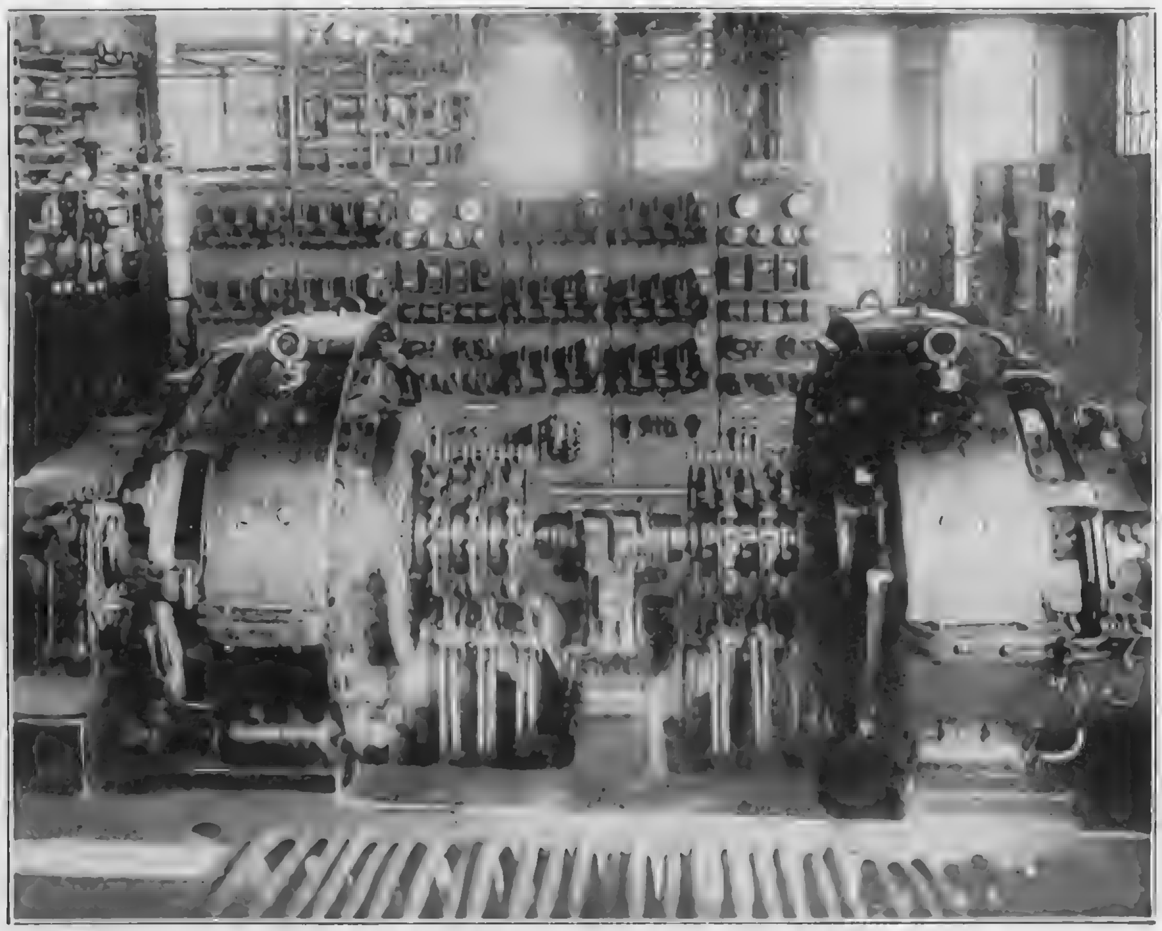
Typical of the Enterprise and Determination of the Japanese Manufacturers to Keep Abreast of their Competitors and Meet the Requirements of their own Market. Two of these 59-ton Electric Locomotives, 1,500 volts, d.c., were made by the Hitachi Engineering Works on their own initiative and subjected to the most severe running tests. An American Electric Expert who witnessed these trials declared that the locomotives were in every respect equal to the best foreign product. The two locomotives were then purchased by the Japanese Railway Board and the name of the Hitachi Engineering Works placed on the list of Approved Makers.

The apparatus in the main 1,500-volt circuit consists of the pantograph current collectors with choking coils, an isolating switch and main fuse, the magnetically operated line switches (which, as mentioned above, are interlocked with the camshaft controller), the camshaft controller itself, and the magnetically operated reversers, which are in the main circuit between the main motor armatures and the fields. The pantographs are raised by compressed-air cylinders operated from the brake compressor in the usual way. Each of them is capable of collecting the whole current required by the six motors. The high-tension control apparatus is situated in compartments arranged along each side of the locomotive body. Sliding doors are arranged to cut off these compartments from the remaining part of the interior of the locomotive body, and the doors are interlocked with the main isolating switch, so that it is impossible to obtain access to the high-tension gear when it is alive. The switches have magnetic-shield blow-outs and are closed against a spring, so that there is no time lost in opening.

The control current is obtained from the 100-volt side of a motor generator which is in the center of the locomotive body. Current is taken from this generator to the master controller at each end of the locomotive. The two controllers are similar, and the locomotive may be driven from either of them. From the master controller current passes through the train wires to the position regulator on the camshaft controller, and from thence to the motor which drives the camshaft controller. The position regulator is in the form of a drum-type switch. As the master controller is operated the camshaft-controller motor is started and moves the camshaft controller into the position determined by the master controller. When the camshaft controller reaches this position the armature of the camshaft motor is short-circuited by a relay, the energising of the relay being determined by the position regulator. This short-circuiting brings the camshaft to rest instantly and without any hesitation or over-running. A 20-volt relay is provided in connection with the control circuit, and if the line supply fails the master controller must be brought back to the starting position before power can again be supplied to the main motors when the supply is restored. The line switches are tripped when the master controller is brought into the zero position. These switches are provided with an overload relay which is closed from the driver's compartment. They can only be closed when the master controller is in the zero position.

The motor of the motor-generator set is fed from the 1,500-volt line. The controlling apparatus consists of an isolating switch interlocked with the door of the high-tension compartment and an automatic starter consisting of three small contactors and a starting resistance. A reverse-current relay is incorporated in the circuit, since if the live voltage dropped suddenly the inertia of the set would cause the motor to feed back into the line. This relay inserts resistance in the circuit and safeguards the motor. This motor of the motor-generator set, besides driving the 100-volt generator which supplies the auxiliary circuits, also drives two fans which are carried one at each end of the set. These fans supply forced ventilation air from the main motors. A stand-by supply for the auxiliary circuits is furnished by a battery carried by the locomotive, this battery having sufficient capacity to operate for four hours in case of failure of the motor-generator set.

The locomotive is fitted with automatic air brakes, and the compressor motors are supplied from the 100-volt auxiliary circuit. A vacuum exhauster is also driven from the same circuit. This exhauster is required for use in connexion with the operation of the vacuum brakes on the existing passenger stock. Ultimately it is the intention to change over all stock on the Japanese railways to compressed air brakes, and when this has been carried out the exhausters will be removed from the locomotives. Two or more of these locomotives can be run in multiple unit and driven from a single master controller. The draw-gear and couplings are made to the Japanese railway standard, but arrangements are made so that the present gear can be removed and M.C.B. couplers fitted if desired.



Kanagawa Automatic Sub-Station, Imperial Government Railways of Japan: Westinghouse Relay and Control Switchboard for Two 2,000 k.w. 1,500 volt d.c., synchronous converter units and one of the 2,000 k.w. converter units. The unit consists of two 750 volt d.c. converters and a common bed plate operating in series.

Baldwin Westinghouse Locomotives.

The first two Baldwin-Westinghouse electric locomotives furnished to the Japanese Government railways are designed primarily for local freight service over lines having heavy grades; they may be operated in multiple as a road freight locomotive of 121 tons deadweight. Following are the principal dimensions of the two locomotives: Weight, 120,950-lb.; Weight per driving axle, 30,240-lb.; Diameter of wheels, 49-in.; Rigid wheel base, 9-ft. 1-in.; Total wheel base, 29-ft. 4-in.; Maximum speed, 40 m.p.h.; Starting tractive effect, 30-240-lb.

Two axle hung motors, inside hung and direct geared to the axle, are carried on each truck. These locomotives will be given close supervision while in service with a view to the acquisition of data concerning actual traffic requirements as well as of operation before determining the extent of the general electrification and the type of equipment on the Government lines.

In addition to the locomotives supplied by the Baldwin-Westinghouse Companies to the Government railways several are in operation on the Chichibu railways, a system traversing a district rich in the natural wealth of mines and quarries and noted for its production of raw silk.

For many years this railway was operated under steam power, but increasing freight movement and the ever-present fuel problem made it imperative to seek a solution of the power difficulties. Moreover, the development of electric plants in this district had been rapid and an ample supply of current was ensured. After a careful consideration, therefore, of all the operating factors, a decision was made calling for the electrification of the line from Kagemore to Kumagaya, a distance of 35 miles of main line.

Power is supplied by the Musashino Electric Power Company, transformed through two sub-stations to 1,200 volts direct current.

Three multiple unit cars, equipped by the Westinghouse Company, will be operated in passenger and express service. Five Baldwin-Westinghouse electric locomotives were shipped in October 1922 to handle mixed freight and passenger trains, which as a rule consist of four passenger cars and fourteen goods cars, making a total of approximately 204 gross tons. The electric locomotives are of the 0-4-0 0-4-0 non-articulated type, built for 3-ft. 6-in. gauge track with 38-in. wheels. They weigh approximately 82-150-lb.

Electrification of the Tokaido Main Line

TOKYO-AKASHI

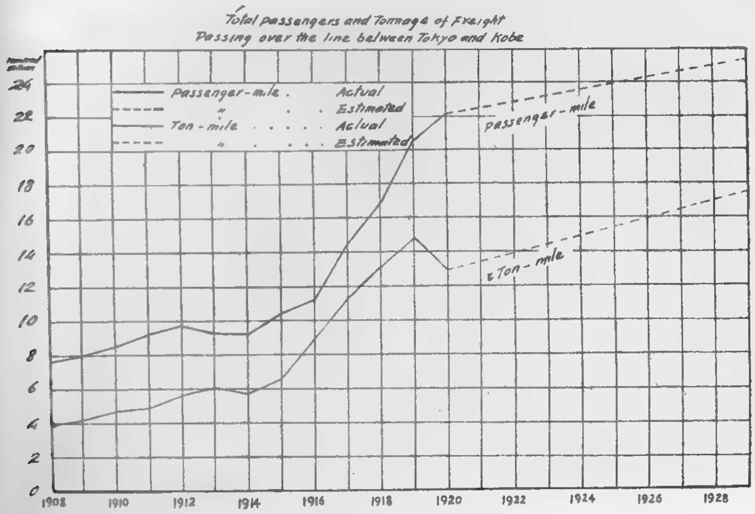
THE second and most important phase of railway electrification in Japan covers the entire Tokaido Main Line between Tokyo and Kobe, a distance of 366 miles. The details for carrying out this plan were drawn up by a special investigation committee and submitted to the Minister of Railways on July 8, 1922. Although various minor changes have since been adopted, this report has been accepted and approved as the official program for electrifying the main line between Odawara and Kobe. In arriving at a conservative estimate of the volume of future traffic over the line, the committee added to the figures for the fiscal year 1921 the estimated increase of the preceding year, the ratio of increase being based on the traffic returns of the nine fiscal years 1908-16. The figures for 1917-20 were omitted from the calculation because of abnormal war conditions. The total passenger and ton-miles between Tokyo and Kobe on which the estimates are based are given in the following table :

Year	Total passenger and ton-miles on the line between Tokyo and Kobe Total passenger-miles	 Total ton-miles	Year	Total passenger and ton-miles on the line between Tokyo and Kobe Total passenger-miles	 Total ton-miles
1908...	763,571,345	389,360,272	1920...	2,214,064,835	1,297,199,652
1909...	801,529,382	425,396,602	Annual increase	36,259,166	51,250,773
1910...	861,511,448	475,492,403	1921...	2,250,324,001	1,348,450,425
1911...	930,809,853	490,662,644	1922...	2,286,583,167	1,399,701,198
1912...	971,280,355	565,979,612	1923...	2,332,842,333	1,450,951,971
1913...	928,657,762	606,680,291	1924...	2,359,101,499	1,502,202,744
1914...	924,349,531	570,475,958	1925...	2,395,360,665	1,553,453,517
1915...	1,051,291,762	665,485,639	1926...	2,431,619,831	1,604,704,290
1916...	1,131,752,043	900,467,322	1927...	2,467,878,997	1,655,955,063
1917...	1,451,562,040	1,146,039,908	1928...	2,504,138,163	1,707,205,836
1918...	1,702,081,111	1,322,275,979	1929...	2,540,367,329	1,758,456,609
1919...	2,056,811,574	1,489,830,885			

The number of passengers and tonnage of freight passing over the various section of the Tokaido lines is shown as follows :

Stations	Passengers Number 1920	 Annual increase	 Basic number of passengers for present scheme	Freight Tonnage 1920	 Annual increase	 Basic Tonnage for present scheme
Tokyo (Shiodome) Shinagawa	26,945,790	223,121	28,953,879	797,096	32,545	1,090,001
Shinagawa Yokohama	21,863,849	297,434	24,540,755	2,714,063	84,907	3,478,226
Yokohama Ofuna	10,220,042	171,445	11,763,047	2,345,592	87,783	3,135,639
Ofuna Kozu	5,654,310	94,222	6,502,308	2,302,791	85,186	3,069,465
Kozu Nagoya	4,076,876	63,380	4,647,296	2,106,066	70,167	2,737,569
Nagoya Maibara	4,157,257	70,549	4,792,198	1,867,052	58,795	2,396,207
Maibara Kyoto	4,873,283	99,687	5,770,466	2,103,966	86,820	2,885,346
Kyoto Osaka	8,027,638	114,178	9,055,240	2,413,875	82,049	3,152,316
Osaka Kobe	8,638,035	229,404	10,702,671	1,902,466	83,261	2,651,815

REMARKS : Numbers of passengers are for both directions but tonnage of freight are for eastbound traffic only.



Train Operation

1. TRAIN UNITS.—The train units for handling this volume of traffic have been determined by the present length of the various yard tracks (which are not to be altered) which permit a maximum length of 800-ft. for passenger and 1,500-ft. for freight trains. The number of these cars to a train with their tractive tonnages are given below, the tonnages being estimated on a seating capacity of 45 per cent. for passenger trains, a loading efficiency of 67 per cent. for freight trains and a tractive efficiency of 85 per cent. for both passenger and freight trains.

Trains	No. of Cars	Tractive Tons
Passenger, Limited Exp.	11	420
Passenger, Express	12	460
Through Passenger	10	300*
Local Passenger...	8	250‡
Exp. and Through Freight	—	800
Local Freight	—	400

*The tractive power of the locomotive is placed at 360 tons with a 20 per cent. margin over the above tractive tonnage.

‡The tractive power of the locomotive is put down at 300 tons with a 20 per cent. margin over the above tractive tonnage.

The composition of some representative trains as shown in the following tables :

(*a*) LIMITED EXPRESS

	OC	1SC	1.2C	DC	2C	2C	2CS	2CS	1SC	2SC	MBC
Seating or Loading capacity	20	30	c c 1 2 20 32	0	64	64	42	42	30	42	ton 11
Dead weight (tons)	36	37	34.5	35	34	34	37	37	37	37	31.5

Total seating capacity, 386 ; Total weight, 421.7 ton or 420 ton ; Dead weight, 390.0 ton ; Weight of passengers, 8.7 ton ; Weight of baggages, 11.0 ton ; Weight of motors, 12.0 ton.

NOTE : 1C, 1st class car ; 2C, 2nd class car ; 3C, 3rd class car ; 1.2C, 1st and 2nd class car ; SC, Sleeping car ; DC, Dinning car ; OC, Observation car ; MC, Mail car ; BC, Baggage car ; MBC, Mail and baggage car ; BV, Brake-van.

(*b*) EXPRESS

	1SBV	1SC	1SC	1.2C	DC	2C	2C	2SC	2SC	2SC	2SC	BC
Seating or loading capacity	28	30	30	1 2 20.32	0	64	64	42	42	42	42	ton 11
Dead weight (tons)	37	37	37	34.5	35	34	34	37	37	37	37	315

Total seating capacity, 436 ; Total weight, 459.8 ton or 460 ton ; Dead weight, 428.0 ton ; Weight of passengers, 8.8 ton ; Weight of baggages, 11.0 ton ; Weight of motors, 12.0 ton.

(*c*) THROUGH TRAIN

	3BV	3C	3C	2C	2C	3C	3C	3C	3.BC	BC
Seating or loading capacity	72	80	80	52	52	80	80	80	3 Bton 40 4	ton 9
Dead weight (tons)	26.5	25	26	27.5	27.5	26	26	26	26	25.5

Total capacity, 616 ; Total weight, 297.9 ton or 300 ton ; Dead weight, 263.0 ton ; Weight of passengers, 13.9 ton ; Weight of baggages, 13.0 ton ; Weight of motors, 8.0 ton. The tractive power of the locomotives for through passenger trains should be such as to leave a margin of 20 per cent. over the regular tonnage of the train.

(*d*) LOCAL TRAINS

	3BV	3C	2C	2C	3C	3C	3C	BC
Seating or loading capacity	72	80	52	52	80	80	80	ton 9
Dead weight (tons)	26.5	26	27.5	27.5	26	26	26	25.5

Total capacity, 496 ; Total weight, 237.2 ton or 250 ton ; Dead weight, 211.0 ton ; Weight of passengers, 11.2 ton ; Weight of baggages, 9.0 ton ; Weight of motors, 6.0 ton. The tractive power of the locomotive for local passenger trains should be such as to leave a margin 20 per cent. over the regular tonnage of the train.

NUMBER OF TRAINS.—The increase in the transportation capacity of local trains is to be accomplished by an increase in the number of cars. Only the express and through passenger services will be improved by the addition of more trains and in order to meet any special passenger traffic demand, extra trains corresponding to five per cent. of the regular service are to be worked into the train diagram when it is drawn up. The actual increase in the number of trains has been fixed at 60 per cent. for express and through services and 40 per cent. for local, these percentages being the proportion between the present number of express and through trains and the local. The number of trains in the scheme is shown in the following table :

Section	Passenger					Freight				
	Express or through									
	Regular	Extra	Total	Local	Total	Express or through	Local	Irregular	Total	Total
Tokyo, Shinagawa, Shiodome ...	20	2	22	8	30	7	—	1	8	38
Shinagawa, Yokohama, Takashima	20	2	22	8	30	18	9	4	31	61
Yokohama, Ofuna, Takashima	20	2	22	8	30	15	11	4	30	60
Ofuna, Kozu	20	2	22	8	30	14	11	4	29	59
Kozu, Nagoya	20	2	22	8	30	13	9	3	25	55
Nagoya, Maibara	20	2	22	9	31	13	5	3	21	52
Maibara, Kyoto, Umekoji ...	22	2	24	12	36	16	5	3	24	60
Kyoto, Osaka, Umekoji ...	26	2	28	28	56	17	5	3	25	81
Osaka, Kobe	32	2	34	32	66	12	11	3	26	92

EXPLANATION : The number or trains on this table in half of the total for both directions in the case of passenger trains, and that of eastbound trains in the case of freight trains.

TRAIN SPEED.—The running speed has been fixed according to the number of trains shown above and the capacity of the electric locomotives. The limited express passenger trains (*a*) will run at an average speed of 38-40 miles per hour ; express passenger (*b*) 36-38 miles ; through passenger (*c*) 29-34 miles ; local passenger (*d*) 29-30 miles ; express and through freight (*e*) about 23 miles and local freight (*f*) about 22 miles.

ELECTRIC LOCOMOTIVES.—The electric locomotives to be used for each kind of train are as follows : (details are given below).

Kind of trains	Electric locomotives to be used					
	Type	Wheel arrangement	Motor capacity	Total Weight	Diameter of driving wheel	Gear ratio
			HP	ton		
Limited express passenger	A	oOO+OO—OO+OOo	250×8	114	49	2.25
Express & through passenger ...	B	oOOO+OOOo	„ ×6	78	„	2.5
Local passenger ...	D	OO+OO	„ ×4	52	„	3.14
Local freight ...	D	„	„	„	„	„
Express & through freight	E	OOO+OOO	„ ×6	72	„	„

EXPLANATION : The horse power of the electric motor is that in the case of 675 volts of terminal voltage of natural ventilation.

RUNNING TIME.—According to the schedule worked out for the new electric through service between Tokyo and Kobe, the limited express trains Nos. 1 and 2 will cover the 366.3 miles in 9.32 hours which includes twenty eight minutes for stops, or 2.10 hours less than the present steam schedule. Express trains Nos. 1A and 2A will make the westbound trip in 10.40 hours and eastbound, 1.33 hours. Express trains Nos. 3, 4, 5, 6, 3A and 4A will

Comparison in Times required to reach Destination and Speed of Principal Trains on the Tokaido Line. (Down) (A)

Proposed scheme		Present practice (1921)		Proposed scheme						Present practice (1921)						Decrease (or increase)		
				Times required to reach destination			Average speed			Times required to reach destination			Average speed					
Train number	Class of cars	Train number	Class of cars	Running trains	Stopping trains	Total	Net running speed	Percentage of speed	Train speed	Running trains	Stopping trains	Total	Net running speed	Percentage of speed	Train speed	Running trains	Stopping trains	Total
				h m.	h m.	h m.	miles per hr.		miles per hr.	h m.	h m.	h m.	miles per hr.		miles per hr.	h m.	h m.	h m.
1	1,2	1	1,2	9—04	28	9—32	40.4	100	38.4	10—50	55	11—45	33.8	100	31.2	1—46	27	2—13
1 A	3	—	—	9—39	1—01	10—40	38.0	94	34.3	—	—	—	—	—	—	—	—	—
3, 3 A	3	3	3	10—08	1—02	11—10	36.1	89	32.8	13—10	1—13	14—23	27.8	82	25.5	3—02	11	3—13
5	1,2	5	1,2	10—08	1—02	11—10	36.1	89	32.8	13—14	1—14	14—28	27.7	82	25.3	3—06	12	3—18
7, 7 A	3	7	3	10—39	1—04	11—43	34.4	85	31.3	12—32	1—13	13—45	29.2	86	26.6	1—53	9	2—02
9	1,2	9	1,2	10—01	54	10—55	36.6	91	33.6	12—44	1—06	13—50	28.8	85	26.5	2—43	12	2—55
11, 11 A	1,2	11	2,3	9—32	48	10—20	38.4	95	35.4	12—37	1—13	13—50	29.0	86	26.5	3—05	25	3—30
13	1,2	—	—	9—49	1—01	10—50	37.3	92	33.8							3—12	38	3—50
13 A	3	13	mail 2,3	9—49	1—01	10—50	37.3	92	33.8	13—01	1—39	14—40	29.3	83	25.0	—	—	—
13 B	Mail baggage	—	—	9—49	1—36	11—20	37.6	93	32.3							3—17	3	3—20
A 19	2,3	15	2,3	10—48	1—07	11—55	33.9	84	30.7	15—09	2—22	17—30	24.2	72	20.9	4—21	1—14	5—35
17	2,3	17	2,3	12—33	3—07	15—40	29.2	72	23.4	15—23	2—48	18—11	23.8	70	20.1	2—50	(19)	2—31
Tokyo-Maibara local p	2,3	77	2,3	9—25	1—35	11—00	29.4	73	25.2	12—00	2—06	14—06	23.1	68	19.6	2—35	31	3—06
Express f.	—	401	exp. p.	15—43	3—16	19—04	23.1	57	19.1	19—38	6—42	26—20	18.6	55	13.9	3—50	3—26	7—18

Comparison in Times required to reach Destination and Speed of Principal Trains on the Tokaido Line. (Up) (B)

Proposed scheme		Present practice (1921)		Proposed scheme						Present practice (1921)						Decrease (or increase)		
				Times required to reach destination			Average speed			Times required to reach destination			Average speed					
Train number	Class of cars	Train number	Class of cars	Running times	Stopping times	Total	Net running speed	Percentage of speed	Train speed	Running times	Stopping times	Total	Net running speed	Percentage of speed	Train speed	Running times	Stopping times	Total
				h m.	h m.	h m.	miles per hr.		miles per hr.	h m.	h m.	h m.	miles per hr.		miles per hr.	h m.	h m.	h m.
1	1,2	2	1,2	9—05	28	9—33	40.3	100	38.4	10—50	52	11—42	33.8	100	31.3	1—45	24	2—09
2 A	3	—	—	9—35	58	10—33	38.2	95	34.7	—	—		—	—	—	—	—	—
4, 4 A	3	4	3	9—37	1—01	10—38	38.1	95	34.4	13—22	1—16	14—38	27.4	81	25.0	3—45	15	4—00
6	1,2	6	1,2	9—37	1—01	10—38	38.1	95	34.4	13—18	1—12	14—30	27.5	81	25.3	3—41	11	3—52
8, 8 A	3	8	3	10—02	1—01	11—03	36.5	91	33.1	12—40	1—10	13—50	28.9	86	26.5	2—38	9	2—47
10	1,2	10	1,2	9—34	53	10—27	38.3	95	35.1	12—22	58	13—20	29.6	88	27.5	2—48	5	2—53
11, 12 A	1,2	12	2,3	9—37	53	10—30	38.1	95	34.9	12—37	1—08	13—45	29.0	86	26.6	3—00	15	3—15
14	—	—	—	9—37	1—01	10—38	38.1	95	34.4							3—50	32	4—22
14 A	3	14	mail 2,3	9—37	1—01	10—38	38.1	95	34.4	13—27	1—33	15—00	27.2	80	24.4	—	—	—
14 B	Mail baggage	—	—	9—50	1—35	11—25	37.3	93	32.1							3—37	(2)	3—35
20	2,3	16	2,3	10—39	1—07	11—46	34.4	85	31.1	15—34	2—17	17—51	23.5	70	20.5	4—55	1—10	6—05
18	2,3	18	2,3	12—28	3—09	15—37	29.4	73	23.5	15—23	2—48	18—11	23.8	70	20.1	2—55	(21)	2—34
Maibara-Tokyo local p.	2,3	80	2,3	9—18	1—57	11—15	29.8	74	74.6	12—20	2—05	14—25	22.5	67	19.2	3—02	8	3—10
Express f.	—	400	exp. f.	15—50	4—13	20—03	23.1	57	18.2	19—14	10—00	29—14	19.0	56	12.5	3—04	5—47	9—11

cover the distance westwards in 11.10 and eastwards in 10.38 hours while trains Nos. 7, 8, 7A and 8A will do it in 11.43 hours westwards and 11.03 eastwards. Through passenger trains will make the westward trip in 11.40 hours and eastbound in 11.155 hours while the local passenger trains stopping at every station, are scheduled to make the trip in about 12.49 hours. The through freight schedule is about 15.20 hours and local freight about 17 hours.

The tables on the preceding page give a comparison between the new electric service and the present steam services showing the time to reach destinations and average speed :

Electric Installation and Cost

1. Power Required and Electric System.—It is estimated that about 100,000 kilowatts will be required for the electrification of the entire Tokaido lines between Tokyo and Akashi, a station west of Kobe, and the railway authorities propose to purchase the surplus power from the many private electric power companies operating plants along the line. A network of transmission lines is to connect the various power houses located on the Fuji, Oi, Tenryu, Kiso, Uji and other rivers, each independent of the other as to water supply. The power is to be purchased at the entrance of the direct current substations, so the cost for building power stations, transmission lines, substations, etc., is not included in the estimates of the government scheme. Recognizing, however, that the demand for power is constantly on the increase and that the private companies may not be able to meet the combined requirements of industry and railways, the government has acquired water rights on the Shinano River and approved the construction of a 100,000 kilowatt power plant at this point. Another large steam power plant to be erected at some suitable point for the service of the Tokaido lines is also under consideration. The electric system to be adopted is 1,500 d.c. with the single catenary aerial system approved by the British and French Electrification Committees as the most advanced standard.

2. Lines to be Electrified.—The lines to be electrified are as follows : *Main lines*, 378.3 miles : Yard sidings, 257.4 miles. *Branch lines*, 21.3 miles : Yard sidings, 33.3 miles.

The main line mileage between Kodzu and Numazu is calculated by the Atami cut-off and the electrification between Kyoto and Kobe is based on the projected completion of quadruple tracks. Of the yard sidings belonging to the main lines the above includes the freight switching tracks at Inazawa, Maibara and Syita, while the branch lines to be electrified are as follows :

Sections	miles	Sections	miles
Takashima—Yokohamako ...	2.8	Suita—Miyahara	2.2
Kawasaki—Hamakawasaki ...	2.7	Azumanada—Onohama ...	2.0
Higashikanagawa—Takashima.	1.4	Osaka—Fukushima ...	0.5
Hiratsuka—Hiratsukashisen ...	1.0	Fukushima—Ujigawaguchi	3.1
Numazu—Hebimatsu	2.5	Ujigawaguchi—Sakurajima	1.3
Ejiri—Shimizuko	1.0		
Otsu—Hamaotsu	1.3	Total	12.3

3. Direct Current Substations.—According to the special requirements of each section, either rotary converters or motor generators are to be installed in the various substations. If a rotary converter is used, two 750 volt machines will be connected in series into a set, but if instead, the motor generator is adopted, one generator for 1,500 volts will be used. In either case, one extra set will be installed for reserve at each substation.

The location and capacities of the substations have been decided upon as per the following list based on the train diagrams, voltage drop, wire and other conditions, the distance between every two stations being about 115 miles.

Sections	Substations proposed near stations named below	Unit capacity	Number of sets	Total capacity
		K.W.		K.W.
		1,000	1	1,000
Tokyo-Numazu :	Eirakucho	,,	,,	,,
	Hodogaya ...	2,000	2	4,000
	Ofuna	,,	,,	,,
	Kozu	,,	,,	,,
	Yugawara ...	,,	,,	,,
	Numazu	,,	,,	,,
Numazu-Nagoya :	Kanbara ...	,,	,,	,,
	Shizuoka ...	,,	,,	,,
	Shimada ...	,,	,,	,,
	Kakegawa ...	,,	,,	,,
	Hamamatsu ...	,,	,,	,,
	Futagawa ...	,,	,,	,,
	Gamagori ...	,,	,,	,,
	Kariya	,,	,,	,,
Nagoya-Kyoto :	Nagoya	,,	,,	,,
	Gifu	,,	,,	,,
	Sekigahara ...	,,	,,	,,
	Hikone	,,	,,	,,
	Omihachiman ...	1,500	,,	3,000
	Otsu	2,000	,,	4,000
Kyoto-Akashi :	Yamazaki ...	,,	,,	,,
	Osaka	1,500	3	4,500
	Sumiyoshi ...	,,	,,	,,
	Tarumi	,,	2	3,000

A 1,000 k.w. converter is to be added to each existing substation at Eırakucho and Kawasaki.

Power Lines.—The compound catenary system has been adopted for power-line suspension using a maximum voltage of 1,500 volts direct current on all sections except the Tokyo-Shinegawa section (4.3 miles) which will use 1,200 volts. The steel messenger wire will be 7/13 W. G. No. 6 with No. 19 B. S. hard drawn copper wire for auxiliary messenger service and No. 40 B.S. grooved hard drawn copper wire for the power line. Steel towers with a maximum distance between towers of 300-ft. are to be erected to carry the wires the cost of which has been computed separately for tunnel, bridge and other sections in order to obtain the per mile cost of these different works.

On branch lines timber poles will be used as wire supports for single linetrack and steel towers for double line while as for yard sidings a careful study has been made of the Shinagawa and Kamata stations and two sets of per mile costs have been worked out on the basis of the same study and each of these costs have been applied to the two stations according to the scheme finally approved.

The costs of the complete Toyko-Kobe scheme do not include the work on the additional two tracks between Yokohama and Odawara the Yokosuka line and the sections between Higashi-Kanagawa and Umi-Kanagawa, nor between Nagoya and Nagoya-Minato, Ogaki and Mino-Akasaka and the Taketoya line. For the section between Kodzu and Numazu the Atami cut-off is followed instead of the old Hakone line. Of the yard sidings on trunk lines, the freight siding tracks at Maibara and Suita are also excluded from the estimate. For the section between Kyoto and Kobe, the cost has been worked out upon the basis of quadruple tracks.

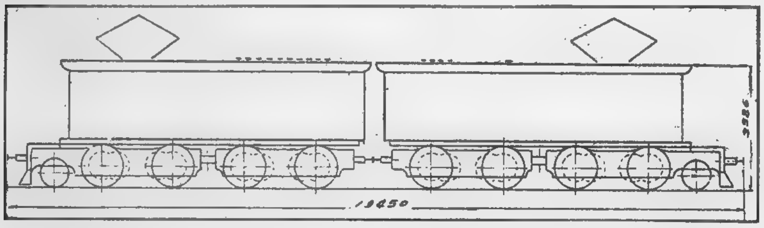
Feeders.—The size of the feeder has been decided separately for each section, according to the locations of the D. C. substations and the train diagrams, and the cost has been computed accordingly.

Size of Feeders

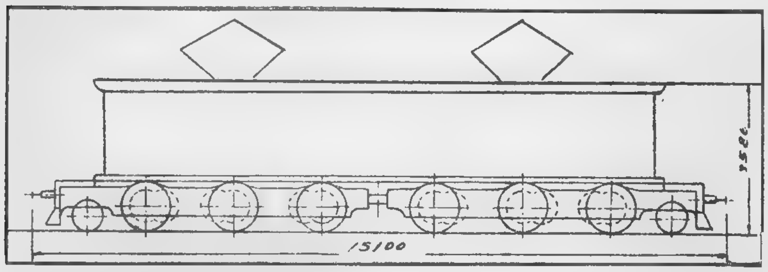
Sections	Mileage	Size of Feeder (10,000 circular miles)
Tokyo—Kawasaki	11.3	0
Kawasaki—Hodogaya	8.4	0
Hodogaya—Ofuna	9.1	0
Ofuna—Kozu	19.4	240
Kozu-Yugawara	13.1	80
Yugawara-Numazu	17.1	160
Numazu—Kambara	17.9	120
Kambara—Shizuoka	15.7	100
Shizuoka—Shimada	17.1	,,
Shimada—Kakegawa	13.4	80
Kakegawa—Hamamatsu ...	17.2	160
Hamamatsu-Futagawa	18.4	200
Futagawa—Gamagori	15.0	120
Gamagori—Kariya	19.2	240
Kariya—Nagoya	15.1	120
Nagoya—Gifu	18.8	200
Gifu—Sekigahara	17.3	80
Sekigahara—Hikone	17.4	160
Hikone—Hachiman	14.0	80
Hachiman—Otsu	18.2	200
Otsu—Yamasaki	14.9	80
Yamasaki—Osaka...	18.0	160
Osaka—Sumiyoshi	14.5	80
Sumiyoshi—Tarumi	14.0	,,
Tarumi—Akashi	3.8	,,

Rolling Stock

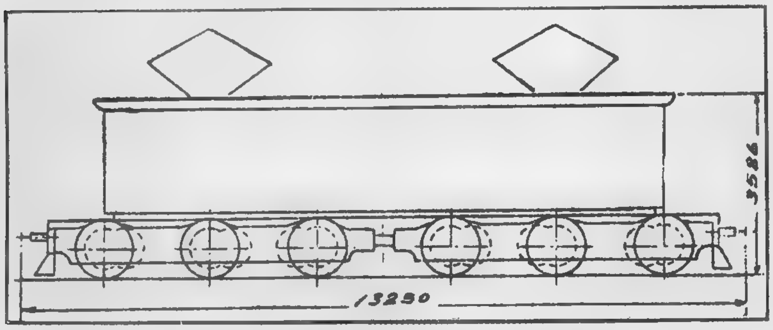
(A) Electric Locomotives.—The electric locomotives to be used will be of the kind known as the Nose Suspension System, in which driving wheels are run by single reduction gears operated by two 750 volt electric motors (insulation to be applied in the case of 1,500 volts) connected in series. The capacity of each motor to be 250 horse power of one hour rating when the voltage is 675 volts with natural ventilation (10 per cent. voltage drop), the same kind of motor to be used in each locomotive. The number of motors,



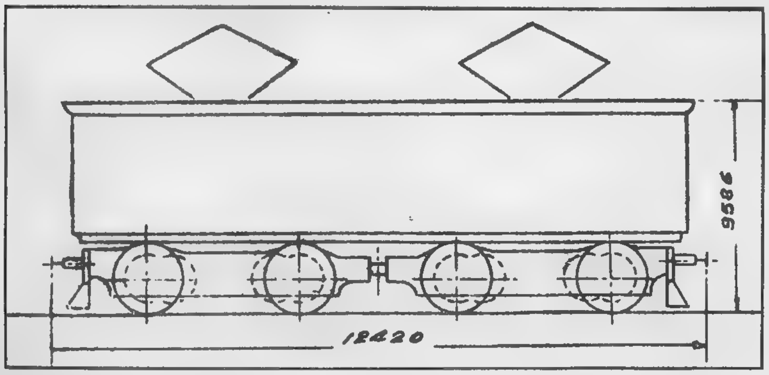
Electric Locomotives for Limited Express Passenger Train: No. of Motors, 8; Capacity, 250 h.p. × 8; Total Weight, 114 tons; Diameter of driving wheel, 49″; Gear Ratio, 2.25.



Electric Locomotive for Express and Through Passenger Train: No. of Motors, 6; Capacity, 250 h.p. × 6; Total Weight, 78 tons; Diameter of driving wheel, 49″; Gear Ratio, 2.5.



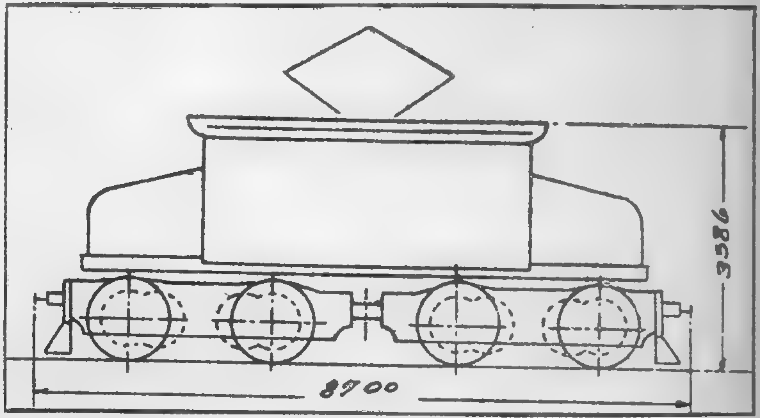
Electric Locomotive for Express and Through Freight: No. of Motors, 6; Capacity, 250 h.p. × 6; Total Weight, 72 tons; Diameter of driving wheel, 49″; Gear Ratio, 3.14.



Electric Locomotive for Local Passenger and Freight: No. of Motors, 4; Capacity, 250 h.p. × 4; Total Weight, 52 tons; Diameter of driving wheel, 49″; Gear Ratio, 3.14.

gear ratio, the diameter of driving wheels, etc., have been decided according to the use to which the locomotives are to be put. One axle with leading wheels are to be put on at each of the front and rear ends of the locomotives for high speed limited express, and ordinary express and through trains for passenger service.

The capacity and the number of motors, etc., have been approved as per the following list, after a study of the loading conditions of motors, and the balancing speed of each train on different grades with due reference to the characteristics of the freight train electric locomotives which had been ordered for the use on the Yamato line. Further, the selection of the type of locomotives, etc., has been made in consideration of grades all over the line, and other circumstances upon the basis of the performance curve of each train on representative section.

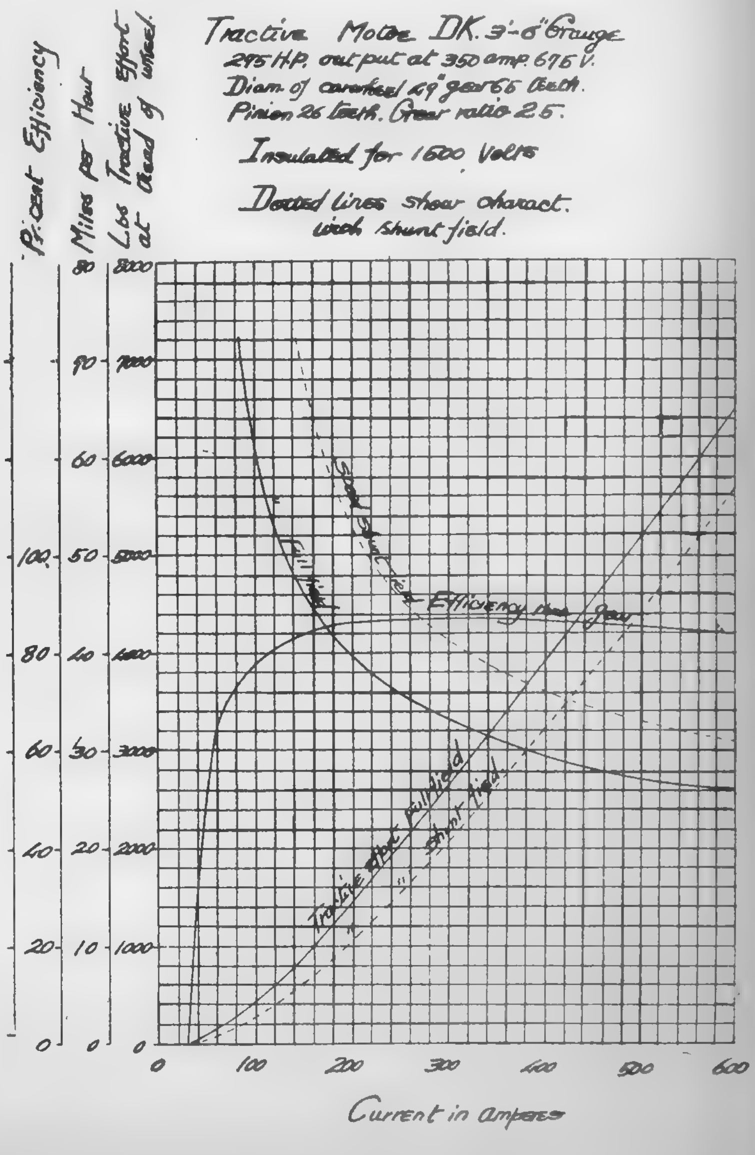


Electric Shunting Locomotive; No. of Motors, 4; Capacity, 150 h.p. × 44; Total Weight, 45 tons.

	Kind of electric locomotives	Wheel arrangement	Motor capacity	Weight (tons) Total weight	Weight (tons) Driving wheel road	Diameter of driving wheel	Gear ratio
			HP.				
A	For limited express passenger	000+00—00+000	250×8	114	104	49	2.25
B	For express passenger	0000+0000	,, ×6	78	72	,,	2.50
D	For local passenger and freight	00+00	,, ×4	52	52	,,	3.14
E	For express and through freight	000+000	,, ×6	72	72	,,	,,
F	For shunting	00+00	150×4	45	45	—	—

Explanation: The horse power of the motor is one available in the case of 675 terminal voltage with natural ventilation.

The following list shows the balancing speed of each train and



the loading conditions of the motors on various grades, when the aforesaid locomotives are used. Motor current per cent. in the list is the percentage to 350 amperes of one hour rating current.

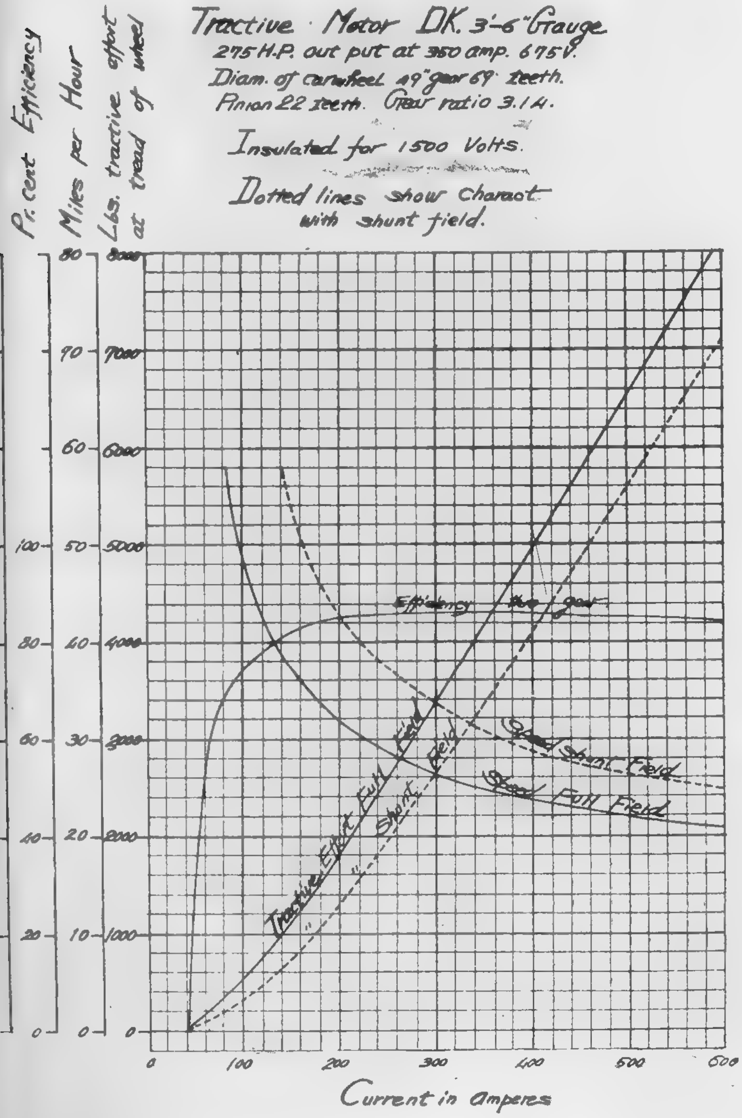
LIMITED EXPRESS PASSENGER TRAIN.—Weight hauled 420 tons; A type electric locomotive: Total weight, 114 tons; Main motors, 8 tons; Diameter of driving wheel, 49-in.; Gear ratio, 2.25.

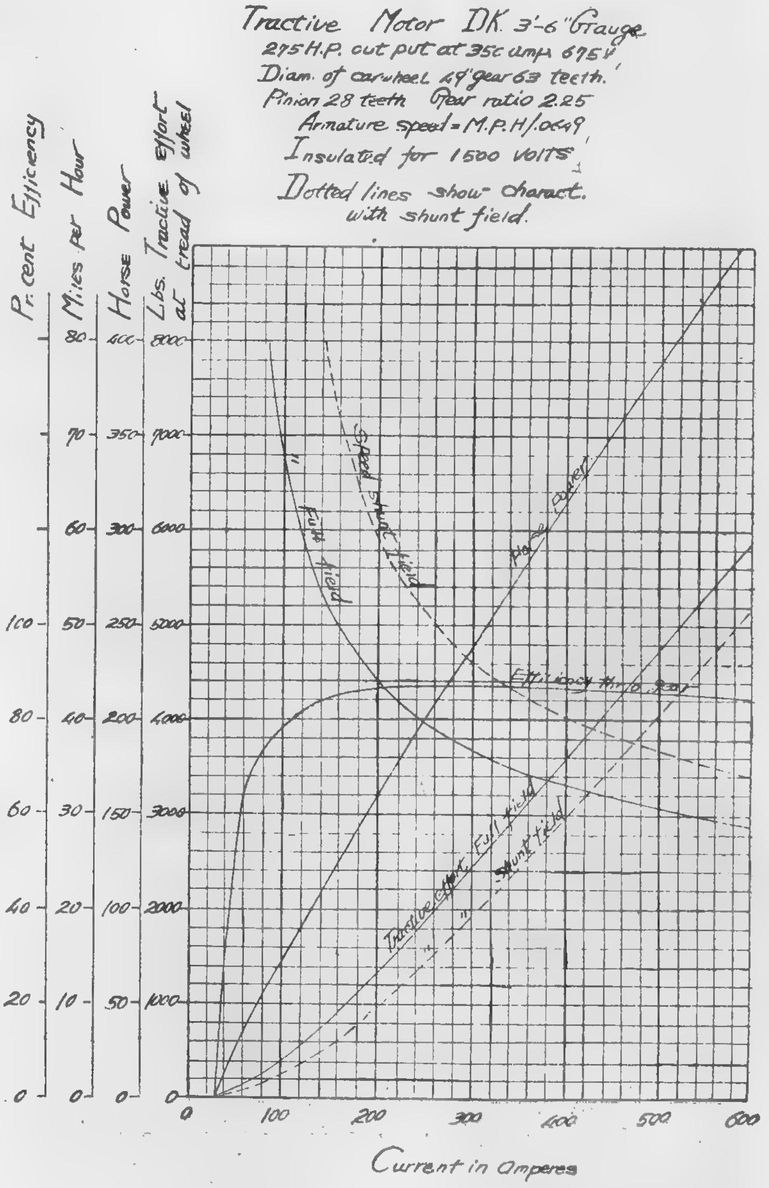
Gradient	Balancing speed (miles per hr.)		Motor current			
	Full field	Shunted field	Full field		Shunted field	
			Ampere	Percentage	Ampere	Percentage
Level ...	52.7	61.2	142	40.6	190	54.2
1/800 ...	49.5	57.7	158	45.2	205	58.5
1/500 ...	48.0	56.0	166	47.2	215	61.5
1/300 ...	45.0	53.1	185	52.8	235	67.1
1/150 ...	41.0	47.9	230	65.7	276	79.0
1/100 ...	38.3	44.2	266	76.0	325	92.9
1/50 ...	33.2	38.0	395	113.0	455	130.0

EXPRESS PASSENGER TRAIN.—Weight hauled, 460 tons; B type electric locomotive: Total weight, 78 tons; Main motors, 6 tons; Diameter of driving wheel, 49-in.; Gear ratio, 2.5.

Gradient	Balancing speed (miles per hr.)		Motor current			
	Full field	Shunted field	Full field		Shunted field	
			Ampere	Percentage	Ampere	Percentage
Level ...	45.3	52.3	152	43.4	202	57.5
1/800 ...	42.5	49.2	173	49.4	222	63.4
1/500 ...	41.2	47.5	183	52.3	234	67.0
1/300 ...	39.0	45.0	205	58.5	255	72.9
1/150 ...	35.2	40.7	255	72.9	308	88.0
1/100 ...	32.5	37.8	305	87.1	360	103.0
1/50 ...	27.7	32.5	450	128.7	515	147.0

THROUGH PASSENGER TRAIN.—Weight hauled, 260 tons; B type electric locomotive: Total Weight, 78 tons; Main motors, 6 tons; Diameter of driving wheel, 49-in.; Gear ratio, 2.5.





Gradient	Balancing speed (miles per hr.)		Motor current			
	Full field	Shunted field	Full field		Shunted field	
			Ampere	Percentage	Ampere	Percentage
Level ...	47.0	54.5	144	41.2	191	54.6
1/800 ...	43.9	51.5	164	46.9	207	59.2
1/500 ...	42.5	50.0	173	49.4	216	61.8
1/300 ...	40.2	47.5	197	56.4	234	66.9
1/150 ...	36.5	43.1	237	67.7	274	78.3
1/100 ...	34.0	40.1	273	78.0	316	90.3
1/50 ...	29.2	34.3	392	112.0	454	129.7

LOCAL PASSENGER TRAIN.—Weight hauled 300 tons; D type electric locomotive: Total weight, 52 tons; Main motors, 4 tons; Diameter of driving wheel, 49-in.; Gear ratio, 3.14.

Gradient	Balancing speed (miles per hr.)		Motor current			
	Full field	Shunted field	Full field		Shunted field	
			Ampere	Percentage	Ampere	Percentage
Level ...	39.7	46.3	133	37.9	175	50.0
1/800 ...	37.2	43.8	150	42.8	190	45.2
1/500 ...	36.3	42.7	155	44.2	200	57.1
1/300 ...	34.4	40.5	170	48.5	220	62.8
1/150 ...	30.8	36.6	210	59.9	263	75.3
1/100 ...	28.5	33.5	250	71.4	305	87.2
1/50 ...	24.0	27.3	385	110.0	445	127.0

LOCAL FREIGHT TRAIN.—Weight hauled, 400 tons; D type electric locomotive: Total weight, 52 tons; Main motors, 4 tons; Diameter of driving wheel, 49-in.; Gear ratio, 3.14.

Gradient	Balancing speed (miles per hr.)		Motor current			
	Full field	Shunted field	Full field		Shunted field	
			Ampere	Percentage	Ampere	Percentage
Level ...	20.2	35.2	122	34.8	163	46.6
1/800 ...	18.3	33.4	152	43.4	180	51.4
1/500 ...	17.3	32.4	167	47.7	190	54.3
1/300 ...	16.0	30.8	193	53.4	210	60.0
1/150 ...	14.1	28.0	243	69.4	260	74.3
1/100 ...	13.1	25.7	298	85.0	310	88.5
1/50 ...	11.5	21.9	440	126.0	490	140.0

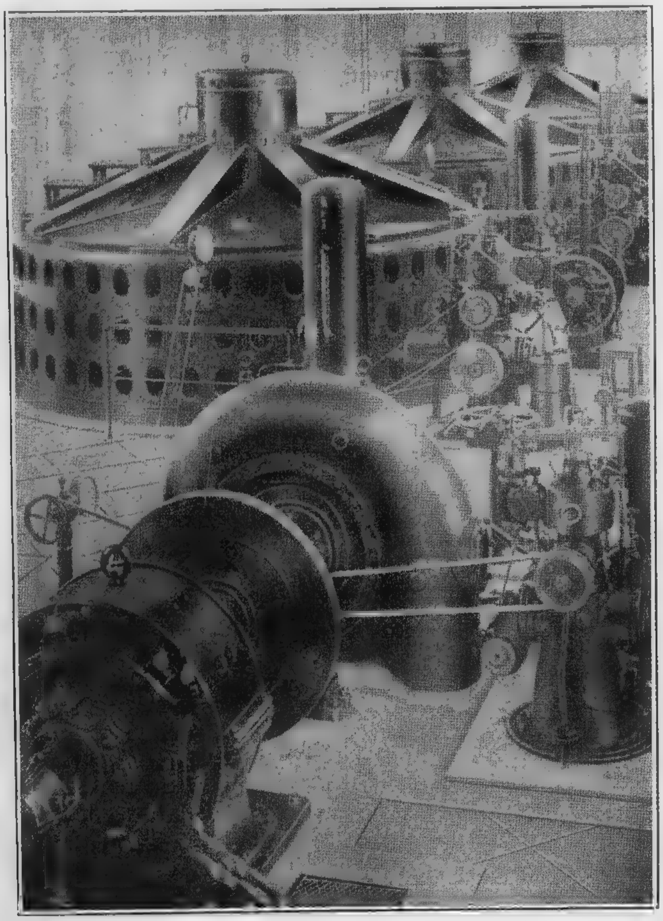
Express and Through Freight Trains.—Weight hauled, 800 tons; E type electric locomotive; Total weight, 72 tons; Main motors, 6 tons; Diameter of driving; Wheel, 49-in.; Gear ratio, 3.14.

Gradient	Balancing speed (miles per hr.)		Motor current			
	Full field	Shunted field	Full field		Shunted field	
			Ampere	Percentage	Ampere	Percentage
Level ...	24.0	33.5	155	44.3	178	50.8
1/800 ...	22.0	31.5	180	51.5	198	56.5
1/500 ...	21.1	30.3	195	55.7	217	61.9
1/300 ...	20.1	28.8	215	61.5	245	70.0
1/150 ...	18.0	26.0	275	78.5	305	87.0
1/100 ...	16.5	24.3	304	97.2	365	104.0
1/50 ...	14.1	20.9	540	154.0	565	161.5

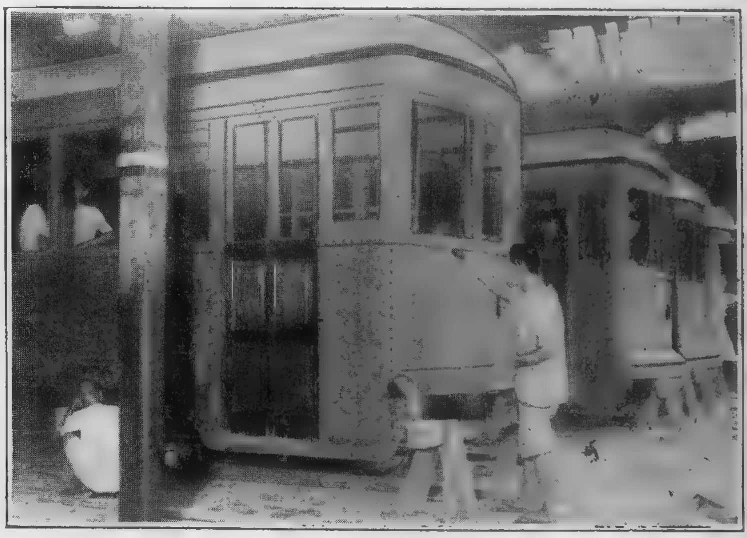
Number of locomotives required and number allotted to various sheds are as follows:

	Kinds of electric locomotives	Number
A.	For limited express passenger trains ...	29
B.	For express and through passenger trains...	46
D.	For local passenger and freight trains ...	107
E.	For express and through freight trains ...	48
F.	For shunting	81
	Total	291

Passenger Cars and Freight Cars.—The present type of passenger and freight cars will be used without any alteration. In the passenger cars, however, 10 one k.w. electric heaters are to be installed. The number of cars to be thus equipped is 1204 for the Tokaido Line and 353 for services between the lines to be electrified and the Hokuroku and the San-yo Lines, total 1557.



Okuwa Power House of the Daido Electric Power Company, 15,000 k.v.a., one of the many Generating Stations feeding into the Districts traversed by the Main Tokaido Railway Line



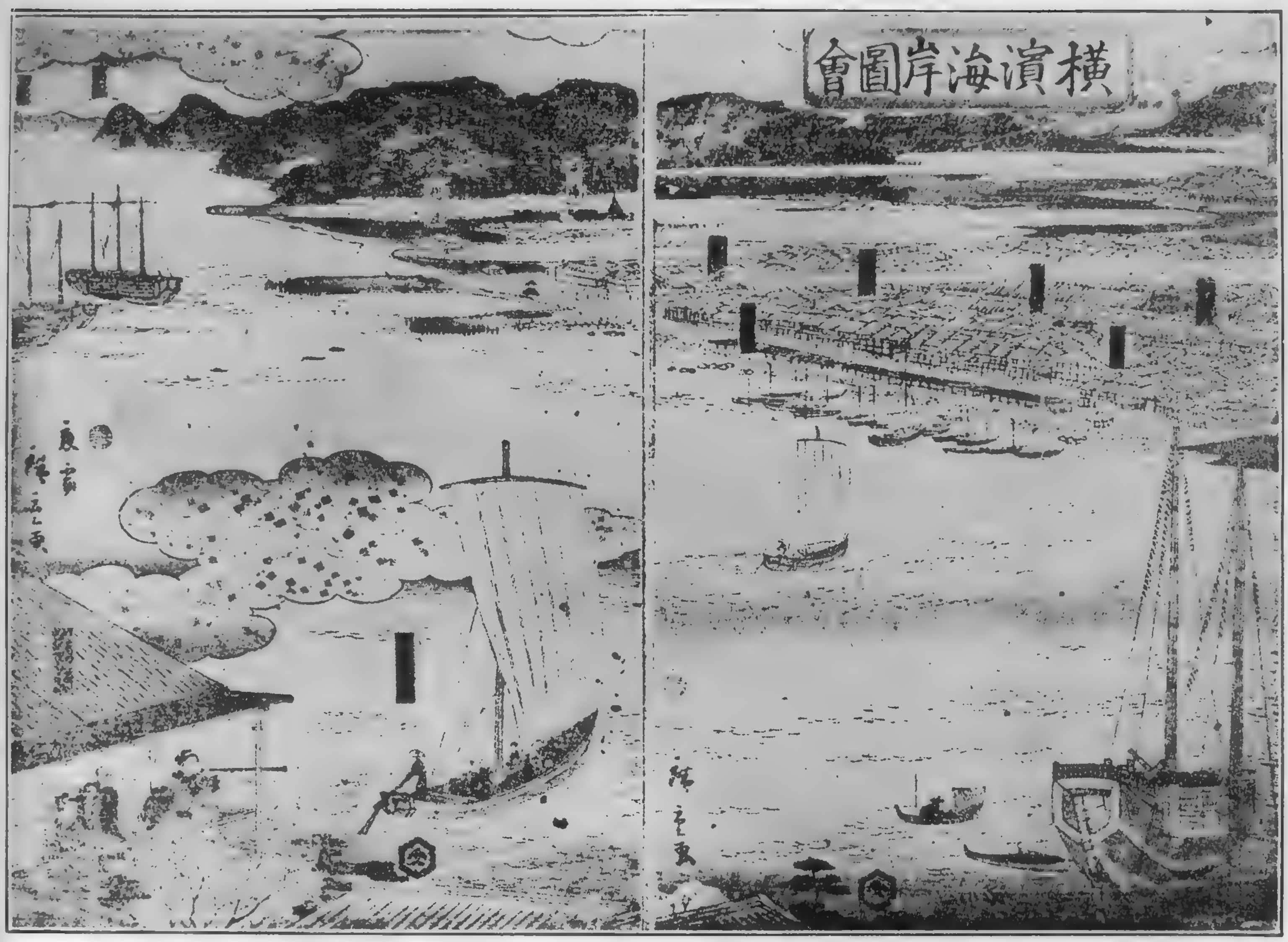
All Steel Cars are now being manufactured in Japan for the Imperial Railways and Private Tramway Lines

Number of locomotives to be allotted to various sheds on the Tokaido Lines.

Sheds	For Limited Express			For Express and Through			For Local			Total		
	Regular service	Extra service and reserve	Total	Regular service	Extra service and reserve	Total	Regular service	Extra service and reserve	Total	Regular service	Extra service and reserve	Total
For passenger trains—												
Ueno (Tabata) ...	8	4	12	23	6	29	4	1	5	35	11	46
Shinagawa	—	—	—	—	—	—	—	—	—	—	—	—
Takashima	—	—	—	—	—	—	—	—	—	—	—	—
Numazu	—	—	—	—	—	—	2	1	3	2	1	3
Hamamatsu ...	—	—	—	—	—	—	4	1	5	4	1	5
Nagoya	—	—	—	—	—	—	3	1	4	3	1	4
Inasawa												
Maibara	—	—	—	—	—	—	2	1	3	2	1	3
Umekoji	—	—	—	—	—	—	5	2	7	5	2	7
Suita	—	—	—	—	—	—	—	—	—	—	—	—
Kobe (Takatori) ...	4	2	6	13	4	17	8	2	10	25	8	33
Total	12	6	18	36	10	46	28	9	37	76	25	101
For freight trains—												
Ueno (Tabata) ...	—	—	—	—	—	—	3	1	4	3	1	4
Shinagawa	—	—	—	11	3	14	—	—	—	11	3	14
Takashima	—	—	—	—	—	—	9	3	12	9	3	12
Numazu	—	—	—	—	—	—	5	1	6	5	1	6
Hamamatsu ...	—	—	—	—	—	—	9	3	12	9	3	12
Nagoya	—	—	—	15	5	20	4	1	5	19	6	25
Inasawa												
Maibara	—	—	—	—	—	—	3	1	4	3	1	4
Umekoji	—	—	—	—	—	—	11	3	14	11	3	14
Suita	—	—	—	10	3	13	2	1	3	12	4	16
Kobe (Takatori) ...	—	—	—	1	—	1	3	1	4	4	1	5
Total	—	—	—	37	11	48	49	15	64	86	26	112
Total—												
Ueno (Tabata) ...	8	4	12	23	6	29	7	2	9	38	12	50
Shinagawa	—	—	—	11	3	14	—	—	—	11	3	14
Takashima	—	—	—	—	—	—	9	3	12	9	3	12
Numazu	—	—	—	—	—	—	7	2	9	7	2	9
Hamamatsu ...	—	—	—	—	—	—	13	4	17	13	4	17
Nagoya	—	—	—	15	5	20	7	2	9	22	7	29
Inasawa												
Maibara	—	—	—	—	—	—	5	2	7	5	2	7
Umekoji	—	—	—	—	—	—	16	5	21	16	5	21
Suita	—	—	—	10	3	13	2	1	3	12	4	16
Kobe (Takatori) ...	4	2	6	14	4	18	11	3	14	29	9	38
Total	12	6	18	73	21	94	77	24	101	162	51	213

Explanation: For limited express trains two locomotives are put together, but the above figures show the number of single locomotives instead of such sets. Locomotives for local passenger trains and those for freight trains are interchangeable in their use. Besides the locomotives shown above 81 locomotives are required for shunting purpose and 6 helpers on the section between Ogaki and Sekigahara.

Improvement of Communication Lines.—Some of the poles for communication lines planted along the lines are to be removed on account of the erection of steel towers for electrification. The cost of such removal has been calculated according to the investigations made by each Divisional Office concerned.



FROM FISHING VILLAGE TO THE PREMIER PORT IN JAPAN IN 60 YEARS
The above is a reproduction of an old Japanese print picturing Yokohama in 1860, viewed from the Kanagawa shore, looking across the bay towards the shore where the Bund of the Settlement now runs, and the Bluff

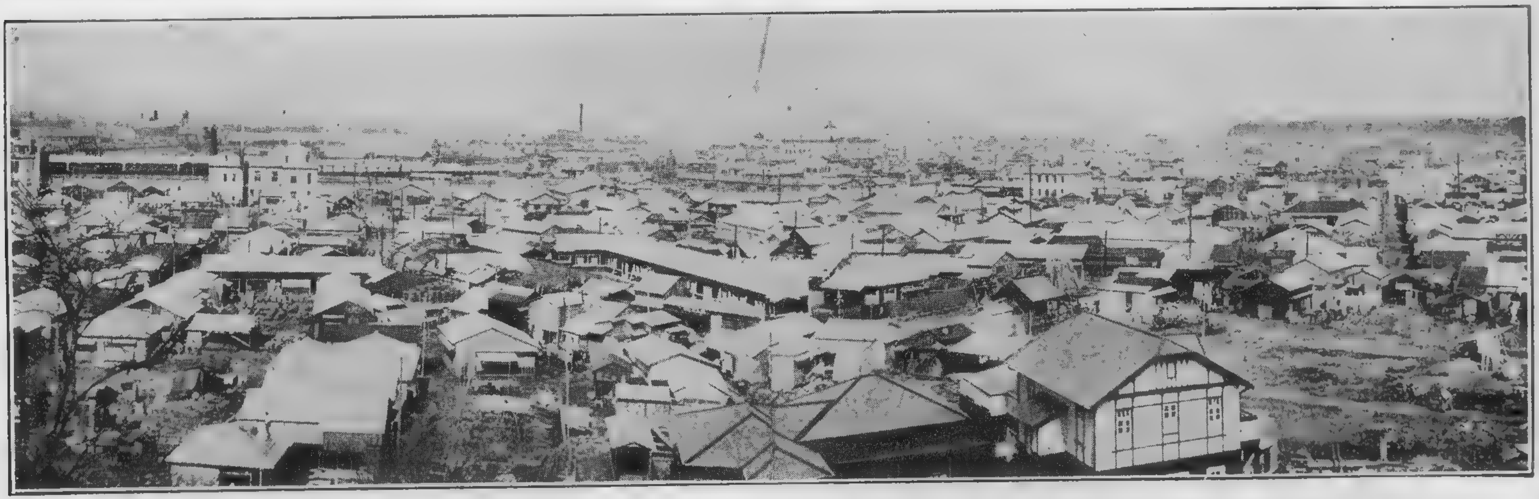
Yokohama Rising From Its Ashes

THE development of Yokohama in the short space of sixty years from a tiny fishing village on a marshy beach to the premier port of Japan has kept step with the equally remarkable rise of the empire to the front rank of world powers. From 100 houses in 1860, the city grew in size until it had a population of nearly half a million in 1919 and was classified by the Diet as one of the six great cities of the empire. In drafting regulations for expanding these six municipalities, the Diet included a plan for a Greater Yokohama that covered the towns of Tsurumi, Machida, Tajima and Kawasaki, together with 23 villages that would quadruple the area of the old city and make Yokohama three times larger than Tokyo. The population of the city had increased to 550,000 in 1920, and it was estimated that in another twenty years it would grow to 1,200,000.

A town planning committee was formed with the idea of speeding up the improvements to maintain the paramount position of the port and facilitate the creation of new industries. Special inducements held out by far-seeing legislators had attracted many industrial plants to Yokohama, and in ten years three big shipyards and several hundred factories of all kinds had taken advantage of these facilities and converted the dreamy old port into a hive of modern industry.

This monument to human endeavor was reduced to a pile of charred ruins and

Motomachi, a Favorite Shopping Street of Yokohama as It Appears To-day



A Year Ago Yokohama was a Dreary Waste of Gaunt Ruins and Brick-strewn Desolation: Temporary Structures Now House a Determined People as They Push Through the Heart-breaking Task of Reconstructing Their City from Its Ashes. View from Nogeyama

smoking ashes after the quake and conflagration had spent their fury in the two days of hell that broke over the city on September 1, 1923. The city that was Yokohama was wiped off the map. Buildings, roads, bridges, the harbor, factories, in fact, all public utilities, were so badly damaged that it would be difficult to convey any accurate idea of the work that had to be done to restore them to a condition that would meet the needs of the population. The population dwindled in a few days to 300,000, but as time passed the people returned to their old homes, and now Yokohama has a population of about 380,000.

Out of a total of 94,000 houses 56,000 were consumed in the fire and 18,000 collapsed, leaving intact some 20,000 more or less damaged shelters as a nucleus for the new city. Out of a total of 206 bridges scattered throughout the city, 74 were completely destroyed and 120 rendered useless by the failure of abutments and damages to superstructure, roadway and approaches.

The Town Planning Committee, referred to above, divided the city into various zones along the lines that Greater Tokyo was being planned, and about sixty per cent. of the total area (6,900,000 *tsubo*) was set aside for residences; 22.8 per cent. (2,800,000 *tsubo*) for business edifices; and 11.2 per cent. (1,300,000 *tsubo*) for industries. Buildings on both sides of Yamashita-cho, the main street in the old Foreign Settlement, as well as Honcho-dori, Kaigan-dori, Basha-michi-dori, Isezaki-cho-dori, Onoe-cho dori and Choja-machi-dori were to be constructed of fire-proof materials. This plan has been adopted as the basis for the new rebuilding scheme, the National Government lending to the city of Yokohama the sum of Y. 20,000,000 to facilitate the construction of the fire-proof structures by subsidizing the property owners. This building subsidy, as in the case of Tokyo, amounts to about half the difference between the costs of erecting an ordinary Japanese house and a fire-proof structure. In addition to this assistance, much of the fire-proof reconstruction will be undertaken by the Reconstruction Building Company headed by Baron Nakajima, which is to receive a loan of Y.60,000,000 from the National Government, of which Y.10,000,000 is earmarked for Yokohama.

The Reconstruction Budget as finally passed in February 1924 allotted Y.56,589,000 for the five-year period 1923-29 (fiscal year) as the contribution of the National Government for the rehabilitation of roads, canals, bridges, parks, gas, waterworks, sewers, schools, tramways and the expenses attached to replotting. In addition, the municipality has expended large sums and prepared its own budget for reconstruction, the expenditures aggregating Y.168,740,000, spread over a period of 22 years (1924-41). The following itemization includes the appropriation of the Reconstruction Board, and such sums as may hereafter be set aside for the rebuilding of Yokohama:

	Yen.
Reconstruction of Yokohama Harbor	16,000,000
Railways	9,820,000
Telegraphs and Telephones	17,100,000
Roads and Bridges	43,560,000
Canal Work	17,190,000
Sewerage	4,590,000
Water Works	4,250,000
Revision of Land Lots and Boundary Readjustment	7,840,000
Parks	2,730,000
Yokohama College of Technology (Koto Kogyo Gakko) and Prefectural Schools	4,980,000
Public Primary Schools	16,000,000
Public Library	500,000
Hospital and Other Hygienic Measures	1,900,000
Garbage and Rubbish (Disposal) Station	600,000
Social Undertakings	750,000
Central Markets	4,000,000
Gas Works	3,000,000
Electrical Undertakings	13,000,000

In order to carry out the new street plan for Yokohama, the replotting of the land presents many difficulties owing to the peculiar conformation of the territory, and the necessity of following the contours of the Bluff and the crooked streams and canals which

Another View of Yokohama As It Is To-day flow through the city. Land values, however, are lower than in Tokyo and there is less inclination on the part of the property-owners to haggle over prices to be paid for their surrendered holdings. The city has been divided into twelve replotting districts, covering approximately 900,000 *tsubo*, or about one-fourth of the burnt area. The National Government will stand the expense of adjusting five of these districts, covering 320,000 *tsubo*, at an approximate cost of Y.2,600,000 and the municipality will undertake the rest with its own funds.

Under the general plan of the Reconstruction Board for replotting the cities of Yokohama and Tokyo landowners are to be requested to surrender ten per cent. of their holdings where their land is required for carrying out the improvements, and in each "land adjustment" district those landowners who are not called upon to surrender any part of their property will compensate those who are deprived of more than ten per cent. to the extent of their loss in excess of that figure. While this scheme is working fairly well in other parts it has been difficult to apply it to the old Foreign Settlement of Yokohama, where the land is held on perpetual lease from the Japanese Government for a nominal ground-rent and is exempt from further taxation.

Although many of these lots have been sold by their original holders to Japanese, a large proportion remain in possession of the foreigners. Land values have enormously increased as a result of the remarkable growth of the port, and the Japanese authorities in the past have sought to levy taxes over and above the ground-rent stipulated in the original agreement. This question was finally carried to The Hague Tribunal, which rendered a decision against Japan. At the end of the war approximately 650 of these perpetual leases were valid, representing about 1,353,628 square feet, paying an annual rental of Y.60,406. Some of these leases have since passed into the hands of Japanese and reverted to normal tenure, and all plots belonging to enemy subjects were confiscated after the war and also sold to Japanese.

In order to rebuild this main business centre along lines that will fit into the general reconstruction scheme and provide for the future growth of the port, the streets of the old Settlement must also be widened and improved, but the foreign leaseholders are withholding their consent to the "mutual aid and sacrifice" plan until they receive definite assurance that their contribution will not be nullified by some new scheme. In general, however, they support the ten per cent. give-and-take idea, but contend that the street widening scheme is too grandiose for the Settlement, and if this be modified the leaseholders will be relieved of the obligation of finding large sums for compensating those who lose more than ten per cent. of their property. As a consequence of this uncertainty, the Settlement and Bluff residential districts remain a dreary waste of gaunt ruins and brick-strewn desolation. A few makeshift wooden structures have been erected in the Settlement and only a tiny church and two or three bungalows remain of the many handsome residences which adorned the Bluff. The erection of many new office buildings planned by foreign firms to take the place of their destroyed quarters are being held up awaiting a concrete scheme for reconstruction which will not be modified.

On the other hand, the value of the foreign leases along the Bund will be considerably diminished if the Japanese Government should exercise its right to fill in the foreshore and reclaim an area stretching out one hundred yards or more into the harbor. When this scheme was first broached it was explained that the land so reclaimed would be converted into a waterside park, and the announcement was received with great satisfaction by foreigners whose properties would be appreciated in value by such an improvement. This contribution to the general welfare of the Foreign Settlement should have served to offset the sacrifices entailed upon the foreign leaseholders in surrendering their land for necessary improvements. As this concession apparently failed to conciliate them, the announcement was made that the reclaimed area would be covered with warehouses and godowns, which, if carried out, would relegate the old Bund with its historic associations to a side street and depreciate the value of the leases by half. Should the National Government insist upon its right to extend this reclamation and hand the new building sites over to Japanese, it would be well within its rights. Such a step, while meeting with the unanimous disapproval of the foreign leaseholders, would probably

Isesakicho, or Theater Street in Yokohama: New Stores and Moving Picture Theaters Attract the Shoppers and Amusement Seekers

The Horiwarigawa, one of Yokohama's Busy Canals

hasten the solution of a vexatious problem and permit the early rebuilding of the Settlement.

Before the disaster there were 800,000 *tsubo* of streets in Yokohama, of which some 200,000 *tsubo* on the Bluff were comparatively undamaged. In addition to repairing the damaged streets, the plans of the Reconstruction Bureau call for twenty new thoroughfares, twelve of which, aggregating 30,534 meters in length, will be built by the National Government and the other ten, 12,814 meters long, by the municipality. Appropriations by the Reconstruction Bureau provide Y.6,018,000 for new streets in Yokohama, Y.4,729,000 for repairs, and Y.2,712,559 for bridges forming part of the road system, a total expenditure of Y.13,460,000. Further extensions and improvements on the part of the city over a period of twenty years calls for another Y.30,000,000. The municipality will construct the following roads :

Number	From To	Length Meters	Width Meters.
13	Hinode Machi, 1-chome, to Idogaya Machi, Kawata	2,789	16
14	Aoki Machi, Shichikencho, to Sengen Machi	2,768	18—27
15	Omote Takashima Cho to Ogida Nishitobe	1,260	15
16	Koyasu Machi sea-shore to Koyasu Machi Kaminoki	1,364	16
17	Kurumabashi to Yamamoto Cho	600	18
18	Hodogaya Machi no Kawata to Ooka Machi, Ohashi	606	22
*19	Chitose Machi, 2 chome, to Minami Yoshida Machi, Minami Mutsume	1,382	20
20	Nakamura Machi, Nishi-no-tani, to Minami Ota Machi, Nishinaka Kochi	945	16—20
21	Kitagata Machi, Kominato, to ShinYamashita Cho	636	18
22	Maita Machi, Mawaritsubo, to Minami Ota Machi, to Shimizu Kochi	464	16

*Expense to be borne by the Municipal Tramway Bureau, which will use this road for a tram line.

The roads to be built by the National Government are given in the article on Roads. The total area of these new roads will be 800,000 *tsubo* (equal to the area of all the roads in Yokohama before the disaster), with 414,000-ft. of gutters with cement surface. Of the twelve roads to be built by the National Government, having an aggregate length of 31 kilometers, 92 per cent. have been surveyed and working plans for 20 per cent. completed. Work on No. 1 road at Onote-Takashima-cho and the reclamation along the waterfront for carrying it through has been commenced.

The main street system will have as its starting-point the new Yokohama station of the Imperial Japanese Government Railways to be erected on the coast near Kanagawa, and will form part of the Tokyo-Tokohama section of the new national highway. Two roads will start from the Sakuragicho station, one *via* Honcho turning to the left and reaching the quays, and the other *via* Bashamichi to Honmoku through a tunnel. A third main thoroughfare will start from the international bridge, and, passing through the business section of the city, connect with the highway to Kamakura.

Of the 37 bridges to be rebuilt by the National Government, the Hagoromo Bashi and three others are now under construction, and preparations pushed forward to start work on five more, three of which are to be finished in the 1925 fiscal year. On the part of the municipality 11 new bridges are to be built, 50 re-spanned and 20 repaired, a total of eighty. Work on some of these has been started and plans for the rest prepared. All of the old wooden bridges are to be replaced with reinforced concrete structures.

Water Works

Yokohama enjoyed the distinction of having the pioneer modern waterworks in Japan, located at Nogeyama, where a reservoir and settling beds distributed the water by gravity to the consumers in the city. These settling beds and reservoir were so completely shattered that they are beyond repair. There was also a settling tank at Nishiya which escaped complete destruction, permitting immediate repairs and the distribution of a partial supply to the city by September 14. Three hundred and thirty thousand feet of mains, 66,000-ft. of distributing and 162,000-ft. of supply pipes, were rendered useless and all the buildings belonging to the Water Bureau destroyed.

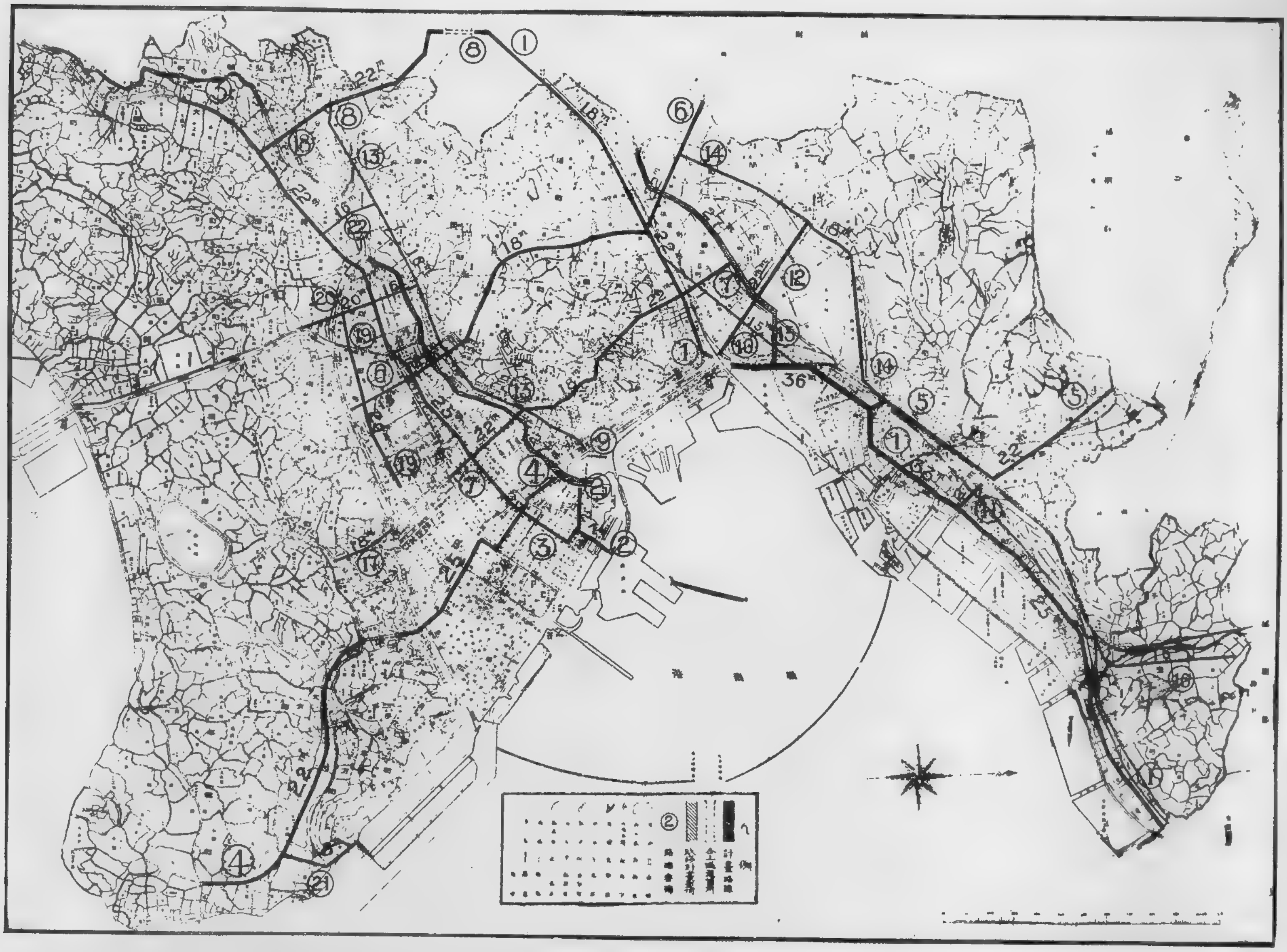
By April of this year the entire water system had been repaired, so that it is now temporarily in the same state as before the disaster. Two new filtration ponds and two new service reservoirs will be commenced in July of this year, to be completed by the end of 1926. Service pipes are to be laid in conformity with the street plans of the Reconstruction Bureau. Before the disaster water was supplied to 85,000 houses, and by April 10 of this year 70,852 houses (including barracks) had been connected up. The water is analyzed daily at the filtration beds and purified by the chlorine process. The Reconstruction Budget sets aside Y.3,000,000 for repairs to the waterworks, of which the National Government will defray one-third. Other extensions projected by the city will raise this to a total of Y.4,250,000.

Nogemachi Street, Yokohama

Gas Works

The gas supply of Yokohama is a municipal undertaking, and in the quake the gas works were badly damaged and most of the distributing mains rendered useless. Rehabilitation consists of restoring the manufacture and supply to 2,500,000 cubic feet per day by a new gas producing and by-products plant, gas holders and other equipment, repairs to buildings and relaying and repairing mains and supplying new meters. New equipment, ordered last July from the Power Gas Corporation of Stockton-on-Tees, to produce 1,000,000 cubic feet per day, is now being erected, and supplementary equipment is also being arranged for.

Repairs to 100 miles of gas mains was commenced last July, and to date 85 miles have been completed. Before the disaster the city



Map of Yokohama showing New Street System: Streets Numbered 1 to 12 are to be built by the National Government; from 13 to 22 by the Municipality

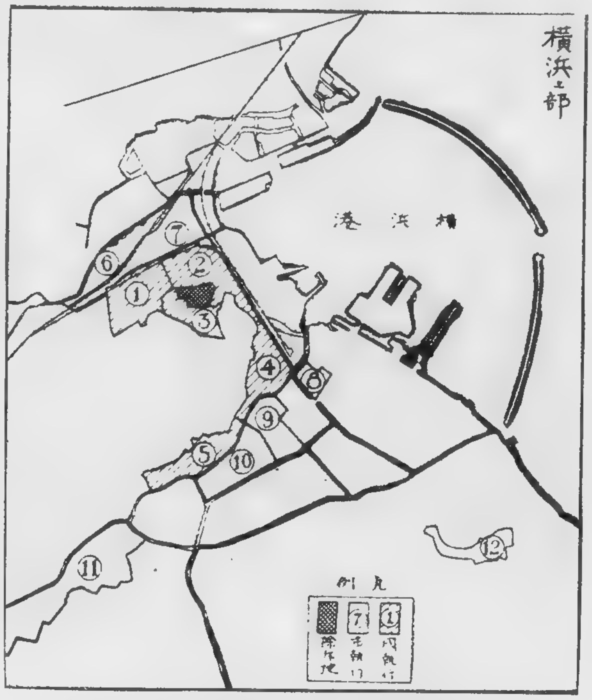
was supplying 2,140,000 cubic feet of gas daily to 22,000 houses, and in June of this year connections were restored to 9,000 houses. By the end of March 1926 the plant will be producing 1,500,000 cubic feet per day and supplying 18,000 houses. The Reconstruction Budget allots Y.3,000,000 to defray the costs of new plant and repairs to the Yokohama Gas Works, which, however, must be borne entirely by the city, as well as the interest charges.

Sewers and Drains

The sewer and drainage system of the city was also completely destroyed by the action of the earthquake, and to facilitate reconstruction the National Government has allotted the sum of Y.1,250,000, bearing half the expense. About 300,000-ft. of sewer mains will be built with this money at an estimated cost of Y.4.25 per lineral foot.

Canals

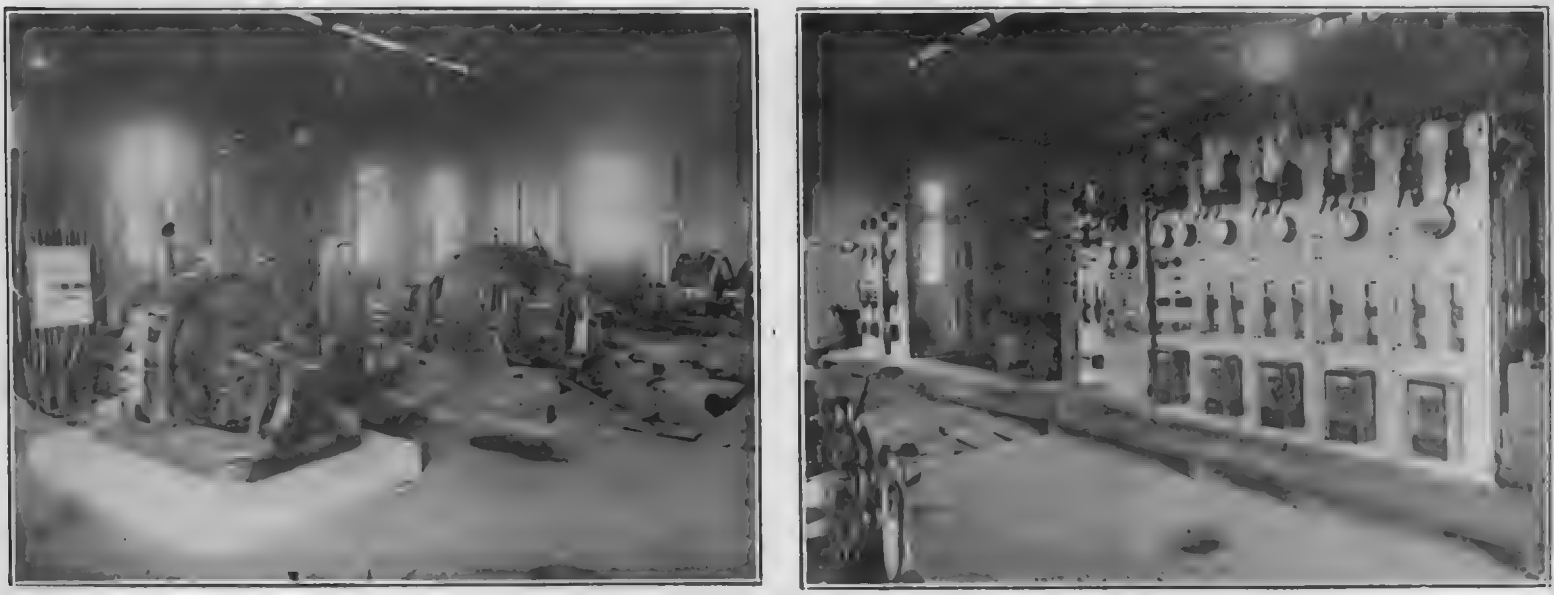
There are five canals in Yokohama—the Katabiri-gawa on the north; Ooka-gawa and Shinyoshida-gawa in the centre; Nakamura-gawa and Horiwari-gawa on the south. The two last are short cuts that connect Yokohama with the Boso districts and the peninsula of Miura, but are too shallow, so the section between the Yawata and Yamashita bridges, about 2,900-ft. in length, are to be dredged to a depth of 5-ft. at low tide and widened from 90 to 108-ft. The Katabara-gawa, running through the factory district to the harbor, is to be dredged to a depth of 5-feet at low tide, and the Ooka-gawa is to be widened to 90-ft. and dredged to 5-feet at low tide. The expenditure for canal improvement in Yokohama is set at Y.5,612,000.



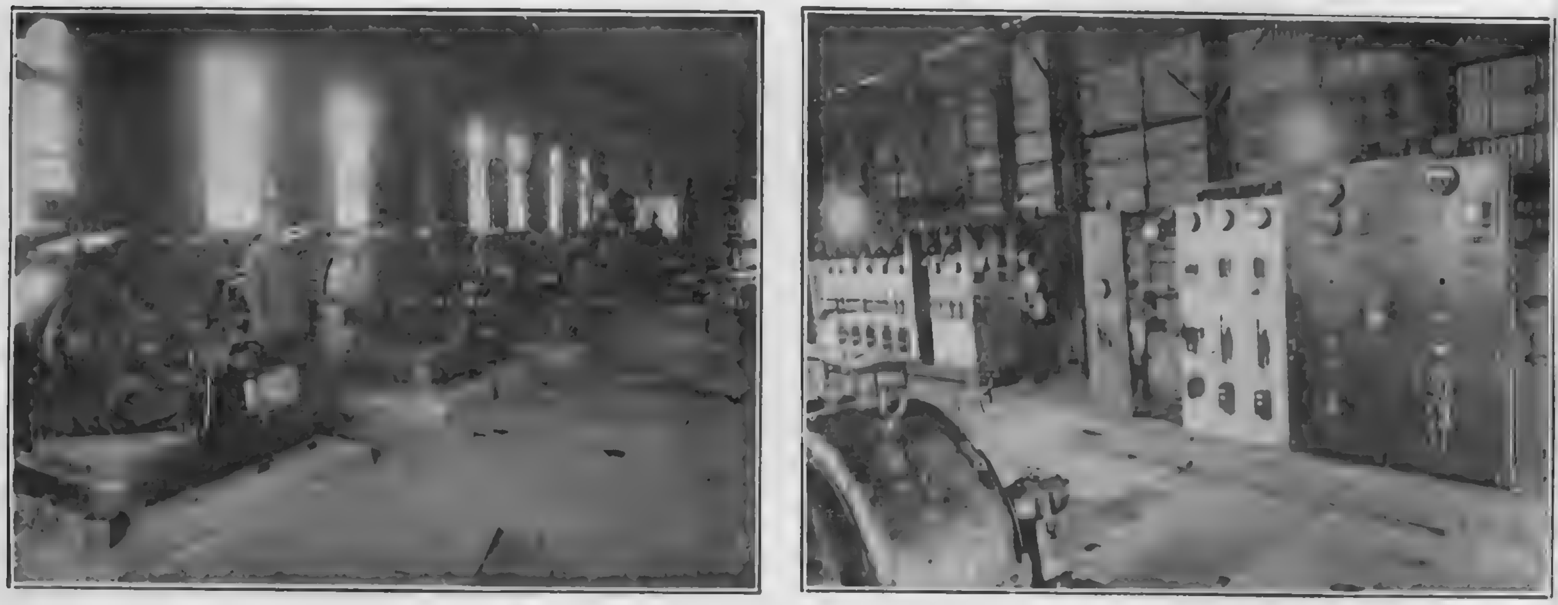
Sketch showing the 12 Replotting Districts of Yokohama. The expenses attached to adjusting the values of five of these districts shown by diagonal lines will be borne by the National Government; the rest by the Municipality

Parks

Four new parks are to be created by the municipality, covering an area of 46½ acres. The principal park is the one referred to in this article along the waterfront to be known as the Yamashita Park, to be formed on the reclaimed area, 3,000-ft. long and 300-ft. wide. The Hinode river, so-called, is to be filled in and used as a park, while another park will be located on the foreshore at Kanagawa. The old settling pond at Nogeyama, which



Chitose Transformer Station and Switchboard



Minato Bashi Transformer Station and Switchboard

Takigashira Car Barns

YOKOHAMA MUNICIPAL TRAMWAYS

The Sub-stations and Car Barns are Temporary Steel Frame Structures Sheathed and Roofed with Corrugated Galvanized Iron Sheets

New 30-ft. Cars of the Yokohama Municipal Tramways, Carrying 70 Passengers

suffered such great damage, as to be beyond repair is also to be converted into a park.

In addition to the above reconstruction plans, the National Government has liberally provided for Yokohama in allotting funds for social welfare institutions, hospitals, schools, markets and other public utilities whose immediate restoration costs are beyond the ability of the city to meet at this time. These national appropriations are to be used up before the end of 1929, when the city will take over the financing of its own program of improvements and extensions.

When the surface lines in Yokohama were taken over from the Yokohama Electric Railway Company by the municipality in 1921 the city acquired 12 miles 14 chains of track, 32.1 miles of low pressure transmission lines, 1,341 wooden poles, 1,055 iron supports, and 107 electric cars, as well as certain office and service buildings and one transformer station.

The lines were then rapidly extended and in many places double-tracked. Progress up to the time of the earthquake was rapid and the value of the properties greatly enhanced. With the exception of the line to Yawata Bashi and one or two other places, the earthquake practically wiped out the entire system. The tracks remained, but in many places it was impossible to run cars over them until new foundations were laid. The fire played havoc with the wires and pole supports; bridges had to be rebuilt and temporary structures erected; the transformer station was a wreck; office buildings were lacking; in fact, all the equipment had to be replaced or repaired before traffic could be resumed.

Interior View of Car

Untiring labor cheerfully performed worked miracles, and by April 1924, six months after the town was laid in ruins, the tramways were again in operation, several additions were made to the lines, and many improvements carried out. At the end of 1924 there were 26 miles of track, of which 13.2 miles were single and 13.8 miles double. In 1924 two new lines were constructed: 1, Honmoku line, 1 mile 15 chains; 2, Isogo line, 1 mile 10 chains. During the present year two more new lines will be completed—the Sugayama line, 1 mile 75 chains, and the Kubo Machi line.

Despite the hard times through which Yokohama has passed since the earthquake, the tramway returns for last year compared favorably with 1922, the year before the earthquake. The number of passengers carried was 48,394,796, and the revenue Y.2,440,914. In the earthquake year 47,679,796 passengers were carried and Y.2,369,760 collected in fares, while in 1922 the number of passengers was 47,424,796, with revenues of Y.2,754,800.

In March and April 1924 only 70 cars were in operation, but by the end of May this had increased to 107, and by July to 120. At the end of December 1924 the Electric Bureau owned 158 four-wheel cars, 2 box freight cars, 6 flat freight cars and 2 water-sprinkling cars.

The Bureau owns two transformer stations, one at Chitose, equipped with one 300 k.w. rotary converter, one 500 k.w. rotary converter, and one 500 k.w. motor converter, with transformers, switchboards, etc. The other station at Minato Bashi is equipped with two 300 k.w. motor generators, 1 rotary converter of 300 k.w. and two motor converters of 200 k.w. There are also well-equipped workshops at the Takagashira car barns, containing all the most modern machines for car repairs and line maintenance.

The financial statement of the Electric Bureau gave its assets on December 31, 1924, as follows: Cash, Y.695,052.52; equipment, tracks, machinery, etc., Y.9,674,792.98; and materials in storage, Y.426,913.75, a total of Y.10,796,732.25.

The income of the Bureau in 1924 was Y.2,440,914.83, and expenditure Y.1,367,782.19, leaving a balance of Y.1,073,132.64 as profit for the year.

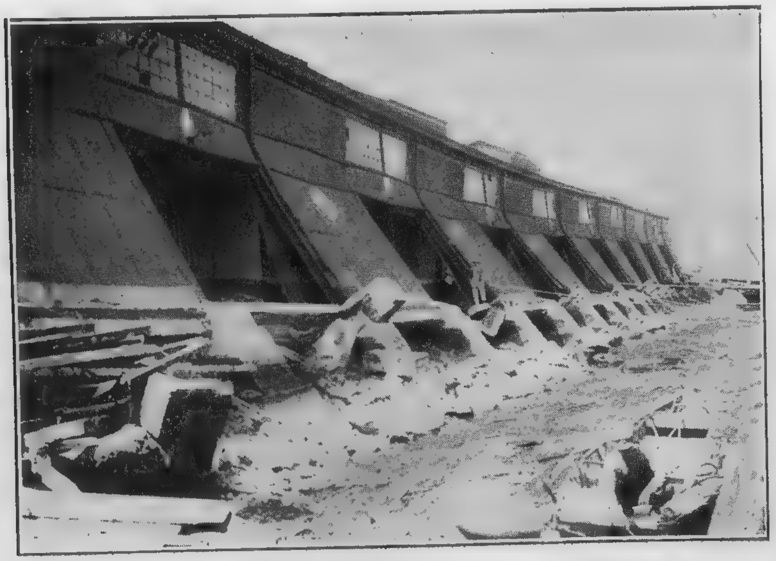
Bashamichi Road, Yokohama

The Key to Tokyo's Future Prosperity

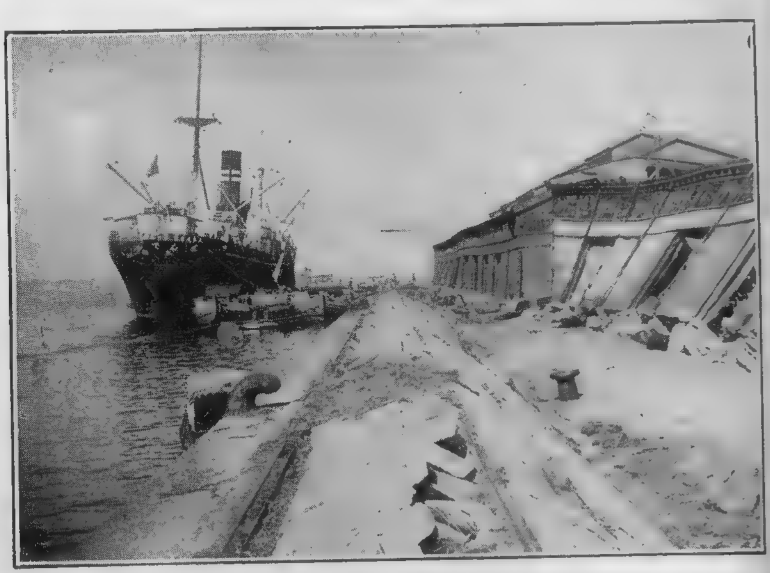
(Continued from page 360)

The details of how this area will be aggregated is shown in the following table:

	Tsubo
First section: adjacent point to compounds of the former Imperial detached palace in Shiba	41,460
Second section: adjacent point to Itchome, Shibaura,..	57,700
Third section: adjacent point to Shinagawa station ..	181,723
Fourth section: adjacent point to Tsukijima	234,699
Fifth section: adjacent point to Etchujima	192,811
Sixth section: adjacent part to the fifth section on the south side	127,944
Seventh section: adjacent part to the sixth section on the east side	225,676



Failure of Quay Wall and Consequent Damage to Warehouse

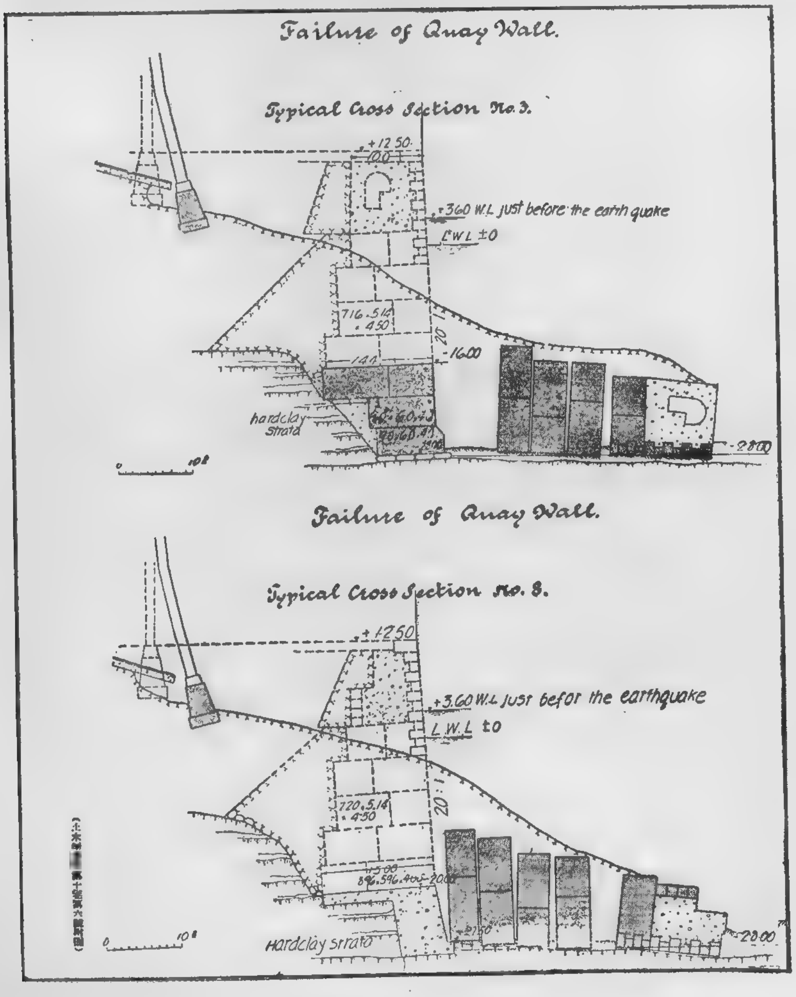


Showing Damaged Warehouse Caused by the Quay Wall Sliding Out

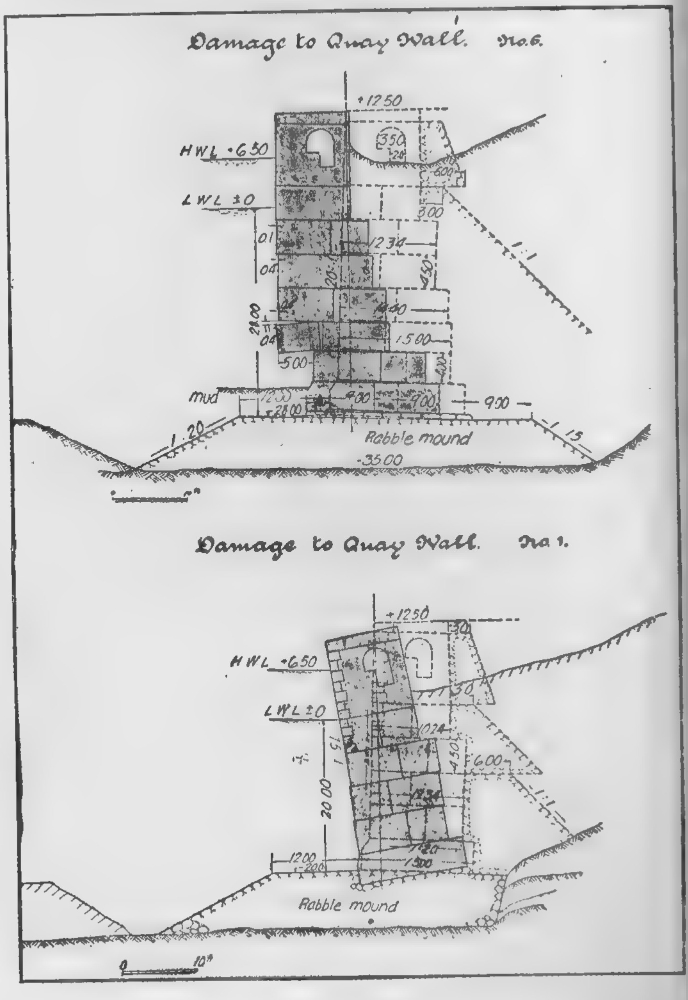
Yokohama's Brilliant "Come-Back"

The Splendid Work of the Harbor Engineers

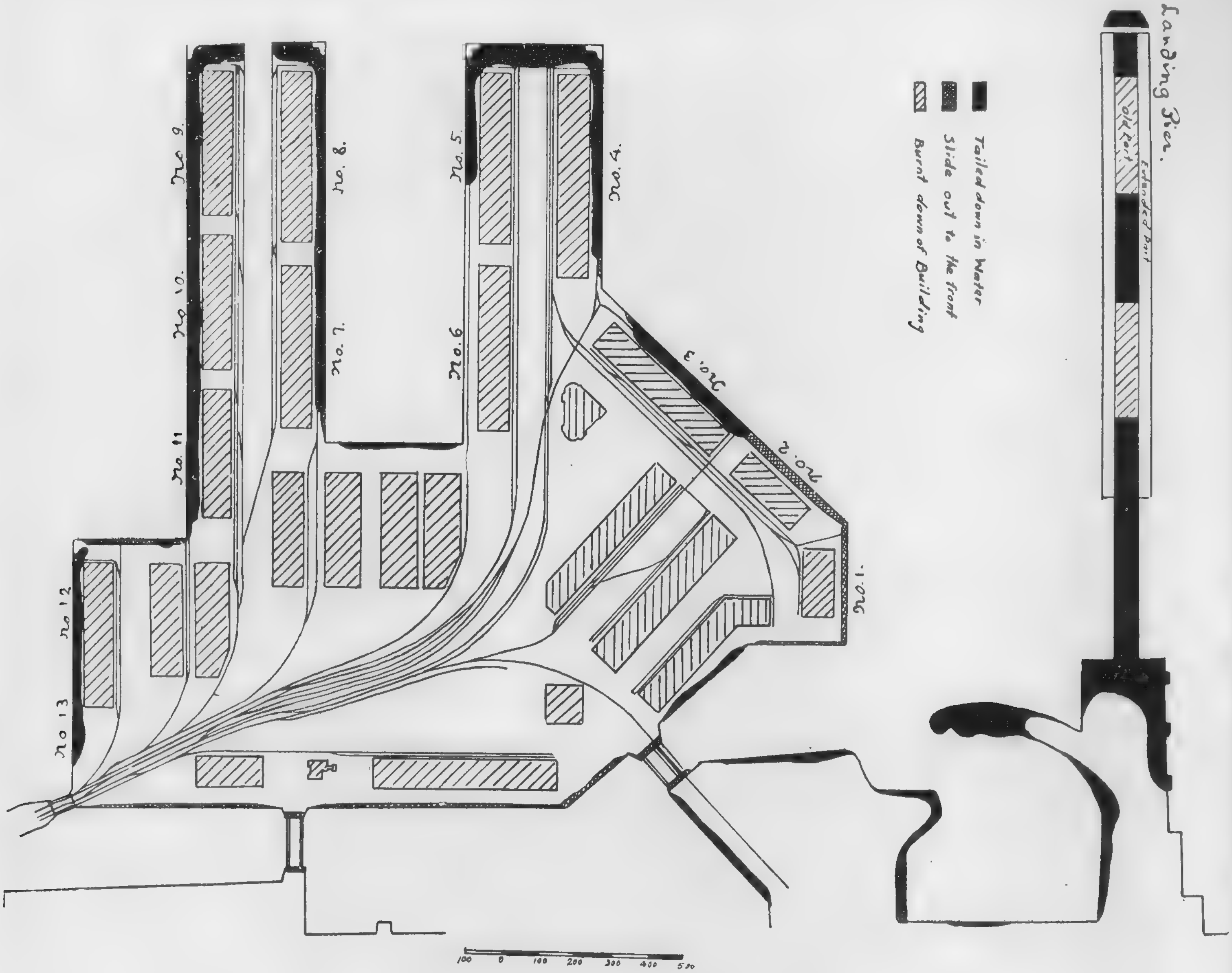
It is no detraction from the splendid work accomplished by other official and private technical organizations in restoring the shattered public utilities of the Tokyo district to state that the task of the Yokohama harbor authorities calls for a very high measure of praise, not for the rapidity with which restoration was carried out, but for the skillful manner that many serious engineering problems were encountered and surmounted. The quake and fire which wiped out the city of Yokohama and destroyed its wharves, quays, breakwater and other harbor facilities struck a blow that menaced the very economic life of Eastern Japan. Yokohama is the main gateway to the country, the port of entrance through which passes a steady stream of travellers and the major articles of import and export upon which the economic prosperity of the empire so largely



Figs. 1 and 2



Figs. 3 and 4

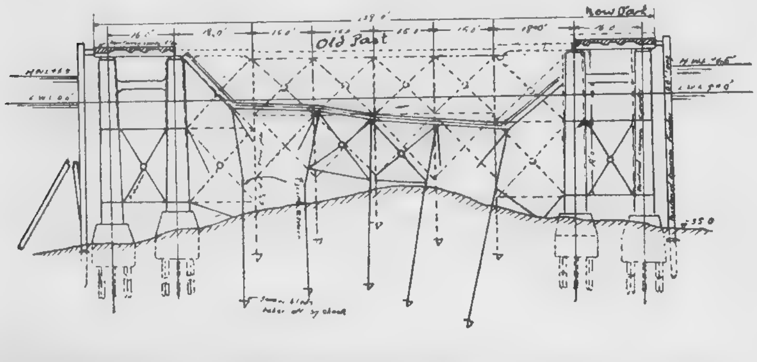


Damage to Port Facilities of Yokohama Customs House

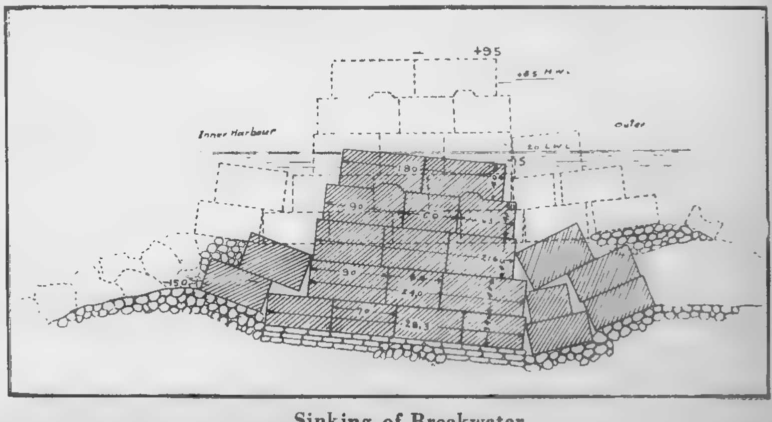
depends. The harbor is filled with vessels flying the flags of all nations, the ocean gateway of a great empire, the front door to its capital city.

Because of the shallowness of Tokyo bay only the smallest coastwise steamers can discharge alongside the inadequate quays of the capital; all major cargo has to be transferred from ocean-going steamers at Yokohama and transported by rail or lighter to Tokyo at a cost which often exceeds the value of the merchandise laid down in Yokohama. A very large percentage of this traffic is made up of the necessities of life, and the extra transportation charges bear heavily on the costs of living in the metropolitan district. Some idea of the importance of this traffic is seen in the following figures. Out of a yearly average of 7,500,000 tons of cargo handled at the port of Yokohama, 3,700,000 tons are destined for or shipped from Tokyo, of which some 200,000 tons are handled by the railway and the balance by lighter. The bulk of the traffic is carried by lighters and barges discharging direct to the warehouses and stores situated along the 50-odd miles of Tokyo's main arteries of traffic, the canals and waterways, which carry an aggregate of 18,000,000 tons of merchandise annually. Any serious breakdown in this vital distribution machinery, increasing the costs of transport between Yokohama and Tokyo, would immediately be felt in higher costs of living.

This is just what happened when the earthquake dislocated the railway facilities and the fire destroyed sixty per cent. of the lighters and threw the task of meeting the abnormal transporta-



Failure of Landing Pier



Sinking of Breakwater

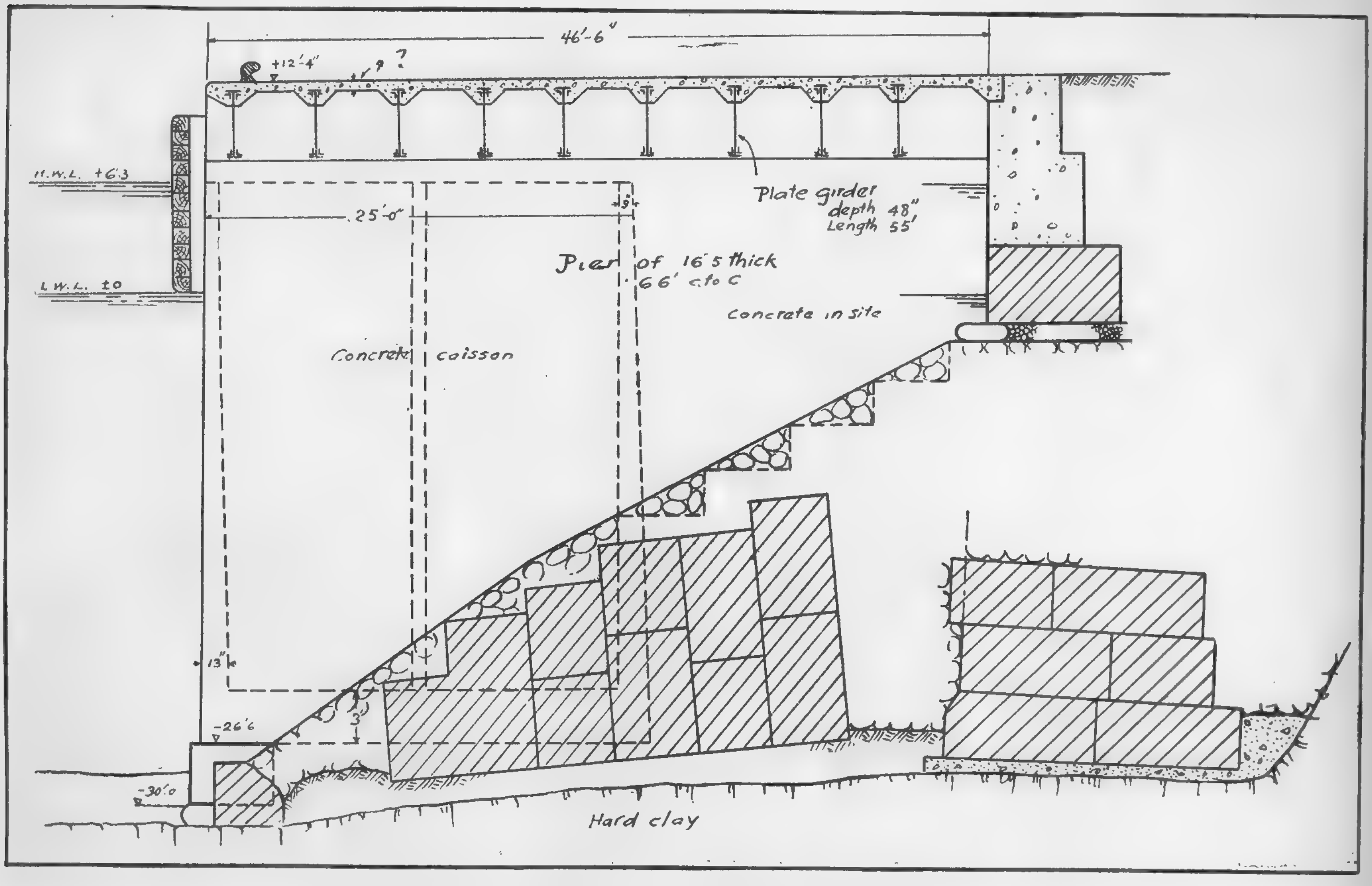


Fig. 7: Reconstruction of Quay Walls Nos. 9, 10 and 11

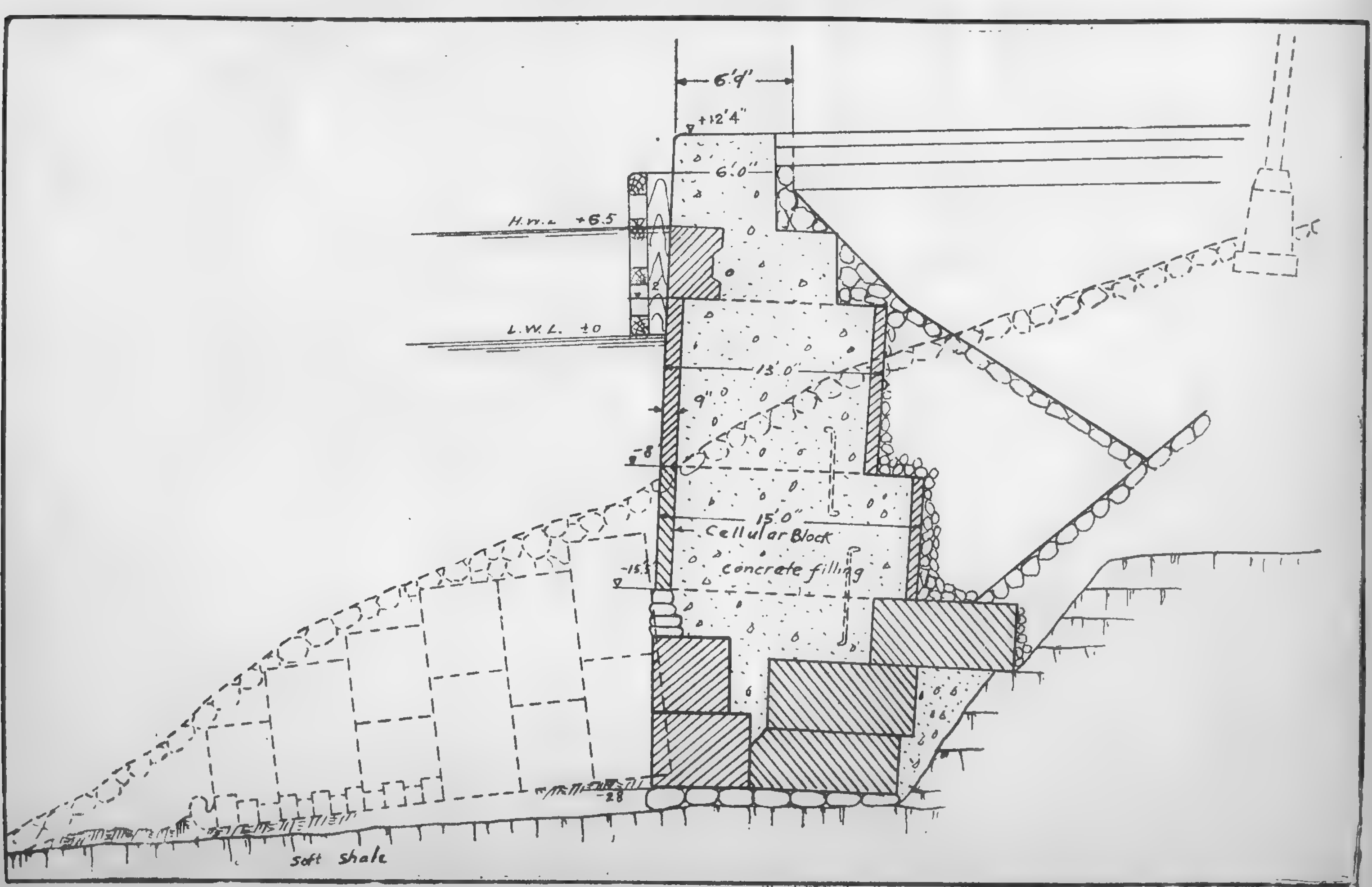


Fig. 8: Reconstruction of Quay Walls Nos. 3, 5 and 8

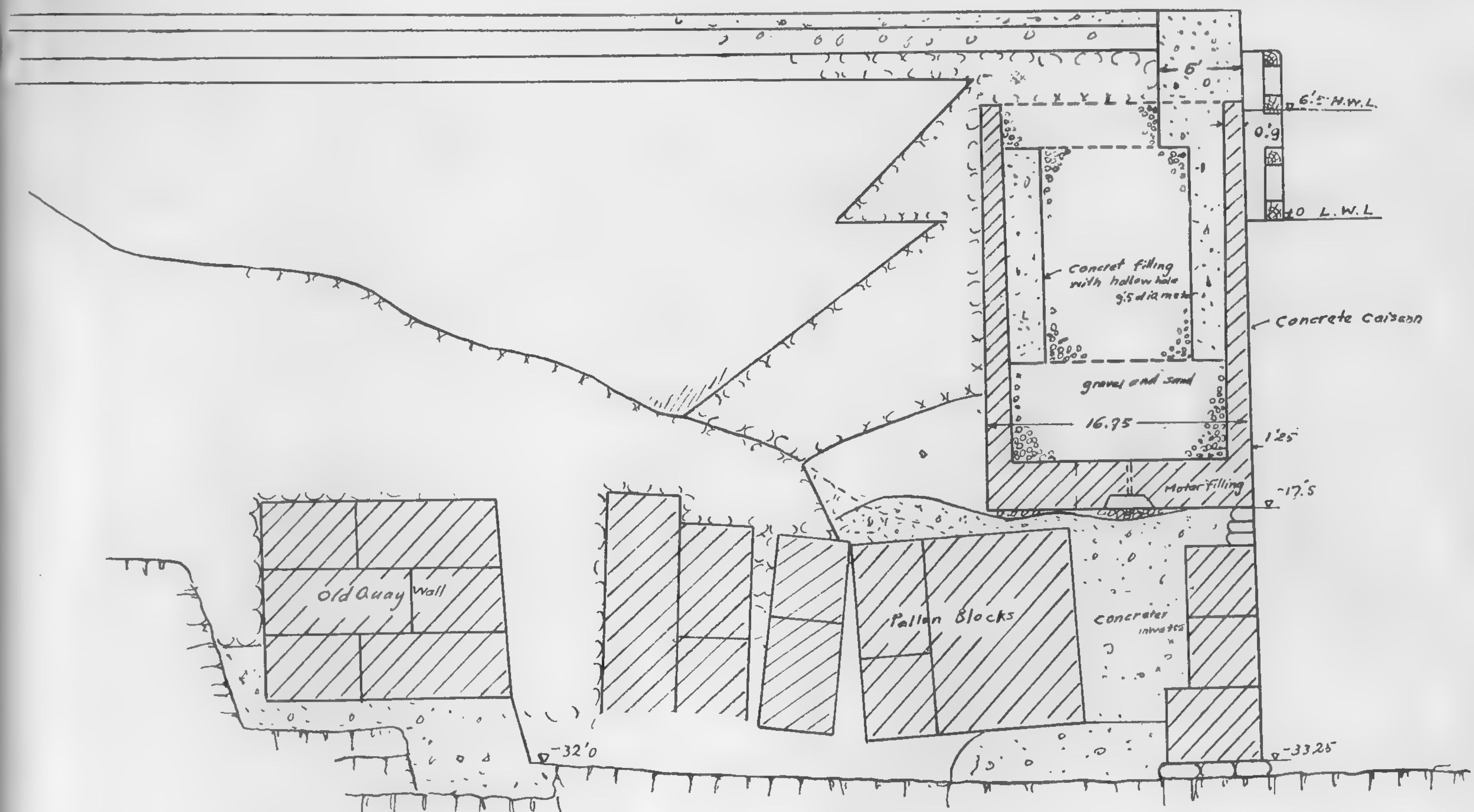


Fig. 11: Reconstruction of Quay Wall No. 4

tion demand between Yokohama and Tokyo upon the 3,000 remaining lighters. The transport charges jumped from Y.1.80 per ton to six and seven yen and over. Not only was the import and export trade of the port brought to a complete standstill, but the immense coastwise traffic supplying the daily requirements of millions of people was paralyzed. Large ships were compelled to creep up as near as they could to Tokyo, anchoring in the offing several miles from the shore, in order to decrease the lighterage on articles of immediate necessity for the relief of the people and erection of temporary quarters.

For the time Yokohama's usefulness was suspended. Heavy cargo could be landed only under the greatest difficulties, and the charges became so prohibitive that the business of the port was diverted to Kobe and articles of prime necessity for the relief and rebuilding of the stricken area unloaded there and transported to Yokohama and Tokyo by rail. Many business houses despairing of early restoration of the port moved their head offices to Kobe, and an agitation was started to divert the huge silk export shipments from Yokohama to this port. The authorities, however, were keenly alive to the importance of Yokohama as the main entrance to the capital, and one of their first acts was to complete plans for rehabilitating the harbor works, appropriating for this purpose Y. 14,000,000. The Home Department of the Imperial Government, entrusted with the supervision of harbors, allocated from its own funds the sum of Y. 9,255,546 towards carrying out the urgent repairs to Yokohama harbor. The appropriation was passed in October 1923, and work started immediately after, in December. That work has been completed, and to-day the facilities of Yokohama harbor are superior to what they were prior to the earthquake. Before describing these works in detail a brief résumé of the damage done to the port will help to understand better what the engineers had to contend with.

The quay wall of the Yokohama Customs-house had a length of 6,620-ft., allowing thirteen vessels to moor alongside at the same time. The height of the wall ranged from 32½ to 45-ft. and the width of the base from 15 to 18-ft. The greater part of the wall was built on a hard clay strata and the balance on rubble mound. The hard clay strata was excavated and massive concrete deposited by means of a pneumatic caisson to form a strong foundation on which concrete blocks (4½-ft. by 5-ft. by 7-ft. and 4-ft. by 6-ft. by 9-ft.) were laid in several layers. The wall was erected in several sections, 36-ft. in length, and the vertical bond of each block reinforced by cement mortar filled in the vertical grooves. Nothing was done to stiffen the horizonal bond, and to this oversight is due to a large part the failure of the quay wall. No wall was overturned from its base, but with the exception of the foundation for the stationary wharf cranes all the walls slid out towards the front, forced out step by step by the vibration of the earthquake. The lower two or three courses of concrete blocks for an extent of 4,800-ft. remained fixed, because they were cemented to the hard clay strata by concrete, but the upper courses were forced out so far by the seismic force that they fell down into the water, causing the back fill to slide out and carry with it the foundations of the warehouses. This accounts for the initial damage done to these structures. The other part of the quay wall, covering 1,440-ft. in length, was forced out from the base where it was built on the rubble mound or the hard clay

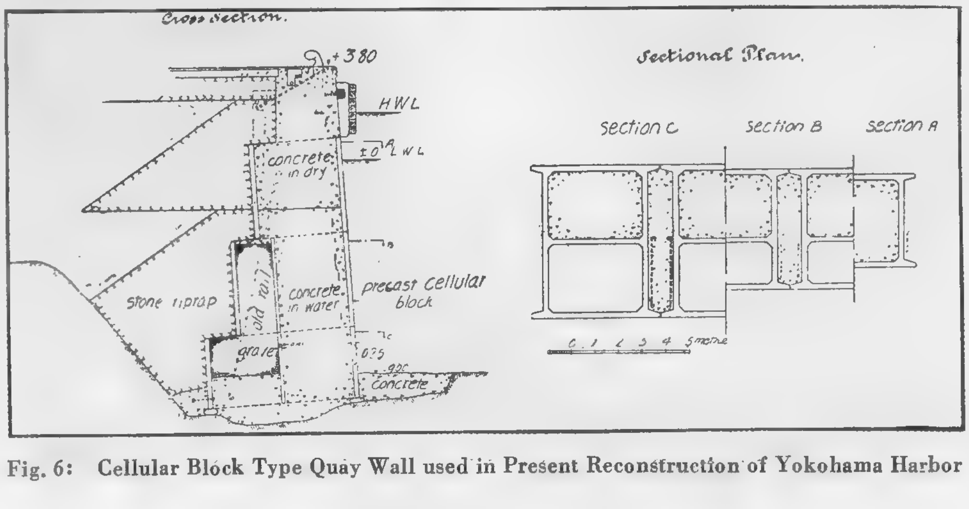
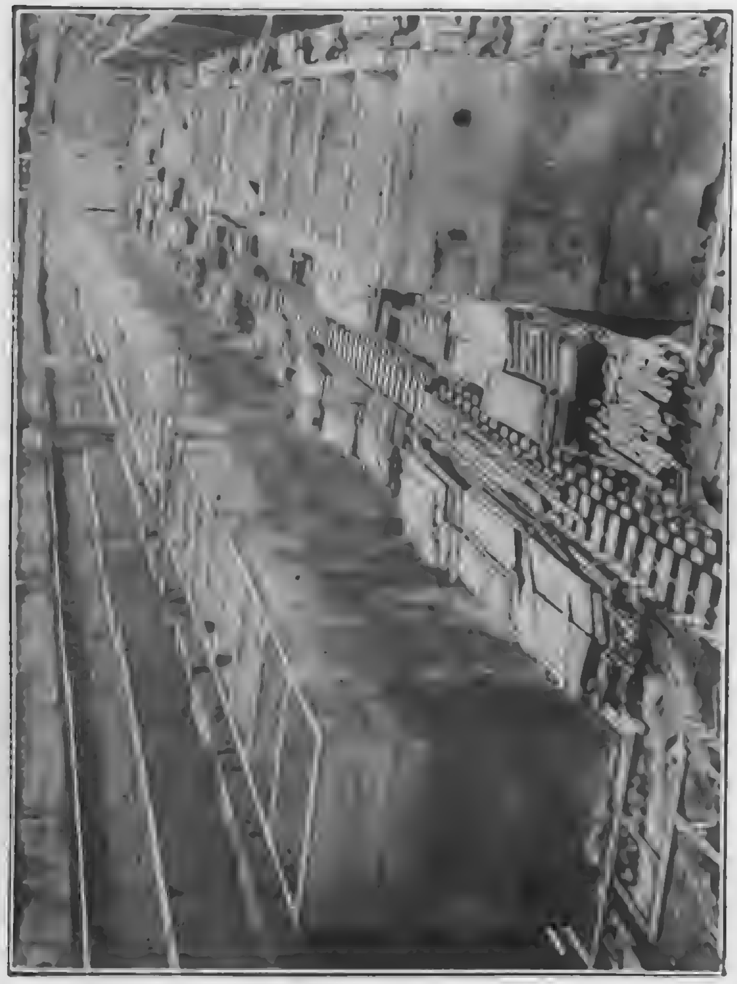
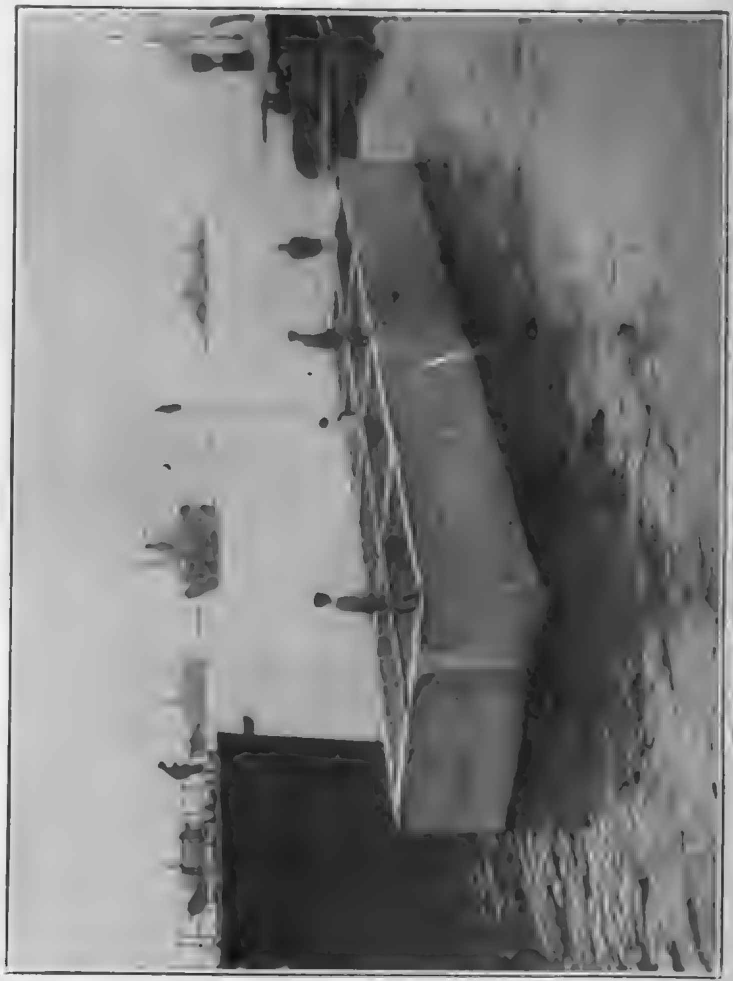


Fig. 6: Cellular Block Type Quay Wall used in Present Reconstruction of Yokohama Harbor

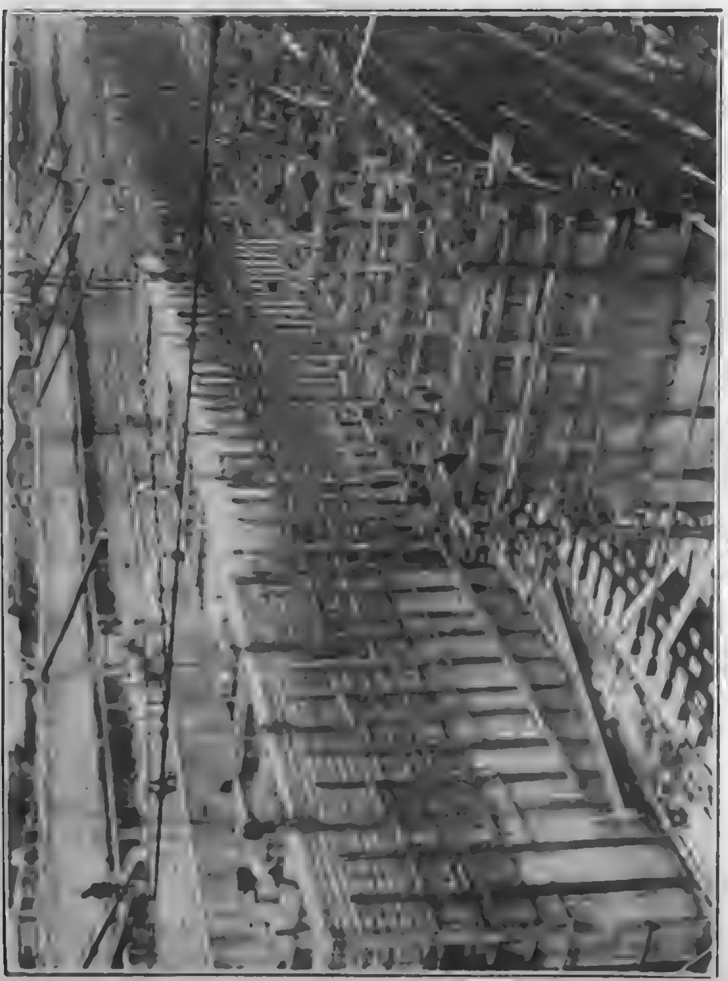
Reinforced Concrete Caissons (17-ft. Wide, 24-ft. High, 51-ft. Long, 430 Tons Weight) for the Yokohama Harbor Reconstruction; Built in the Dry Docks of the Asano Shipbuilding Co.



Completed Caissons Ready to Float



Passing out the Dock Gate into the Harbor



Caissons in Course of Construction

Caissons Afloat Ready to be Towed to the New Quay Construction

Bringing Concrete Caissons in Position for Sinking

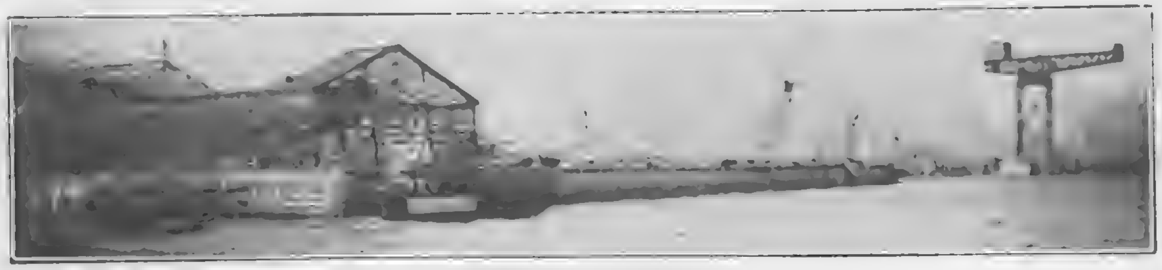
Sinking of Concrete Caissons in Site to make Solid Quay Wall

Foundation Work for Quay Wall

Quay Wall under Construction, Showing Concrete Block Laying, Back-filling and Concreting

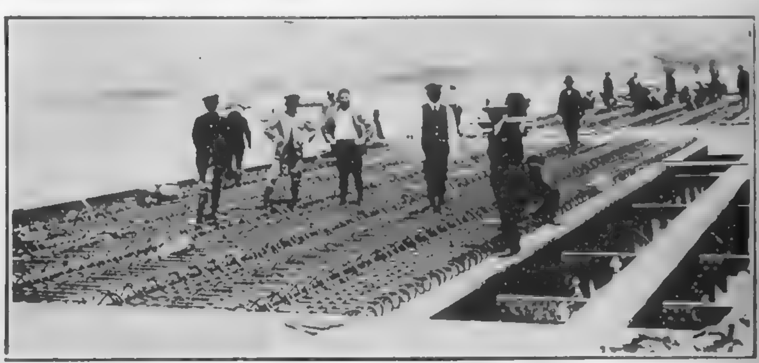
Plate Girders laid on the Reinforced Concrete Caissons filled with Concrete to make the Bridge Type Quay Wall

General View of Bridge Type Quay Wall



Completed Quay Wall

Placing Concrete on Caissons by a Floating Concrete Mixer



Reinforced Concrete Slab Floor on the Bridge Type of Reconstructed Quay Wall

strata without bonding. Moreover, relative displacement between horizontal courses had taken place, the upper courses overhanging the lower in places by five or more feet.

Figs. 1 and 2 show the typical failure of that part of the quay wall built on the hard clay strata and Figs. 3 and 4 show the damage to the walls built on the rubble mound. Fig. 5 shows the section of the foundation for the 20-ton stationary wharf crane which came through the quake without damage. Generally speaking, the foundation of the quay wall was sufficiently hard and the work well executed, but no attention was paid to bonding the horizontal course. Had they been stiffened by providing grooved and tenoned concrete blocks, the quay wall would have not suffered so severely. A highly interesting and valuable study on the general theory concerning earth pressure and seismic stability of retaining walls and dams, from data derived from the effects of the earthquake, has been written by Mr. Saburo Okabe, C.E., engineer-in-charge of the Yokohama Harbor Works, and published in the Journal of the Civil Engineering Society of Tokyo. Mr. Okabe has been for many years in charge of the design and construction of the quay walls in Yokohama, and has arrived at very definite conclusions which are highly valuable to all harbor engineers.

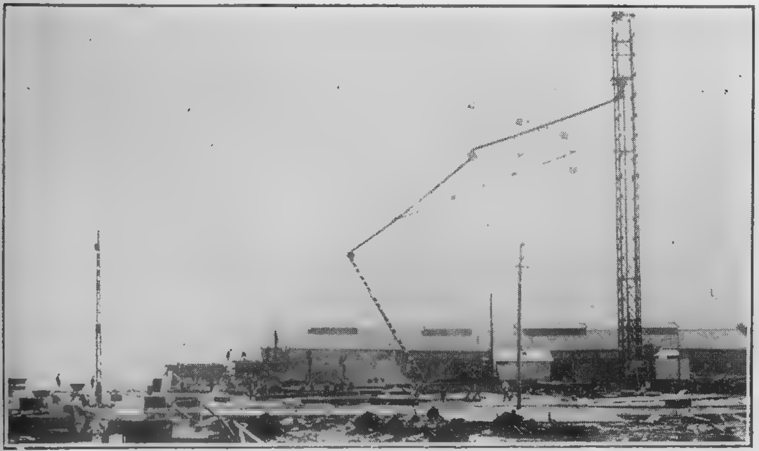
As a result of his recommendations the immediate repairs to the Yokohama quay wall were carried out by sinking reinforced concrete caissons in site and filling them with concrete. These caissons were first built on shore and floated to their place in the wall. The foundation under the caisson was dredged, the caissons then loaded and sunk to the proper position and the interior filled with concrete. Before these caissons could be sunk in place the bottom had to be cleared of the old quay wall blocks and débris in order to prepare a foundation. Many of these blocks weighed 160 tons and had to be broken up by dynamite and then lifted out to be employed on other foundation work or for repairing the breakwater. In carrying out this difficult work a dipper dredger and a rock cutter was employed, as shown in the illustrations accompanying this article.

The general reconstruction of the quay wall under this system is shown in Fig. 7. The caissons were sunk to the hard clay strata, and after being filled with concrete were backed with an earth fill on a concrete foundation extending to a retaining wall. The caissons were then tied together with steel girders 55-ft. long, 4-ft. high and weighing 8½ tons each. In all, twenty caissons were employed for this particular work, each 50-ft. by 17-ft., and 171 girders. The latter were made at Yokohama dockyards. This system was applied to the reconstruction of Quay Walls Nos. 9, 10 and 11.

For the reconstruction of Quay Wall No. 4 the same system was employed, the caissons being 51-ft. long, 16-ft. wide and 24-ft. high, each weighting 430 tons. These were built in the dry docks of the Asano Shipbuilding Company at Tsurumi. Bottomless caissons were also used in the reconstruction of this quay, each weighting 27 tons. In places where the old foundation held, but

Floating Concrete Mixer, 240 cubic yards per day capacity, working on Quay Wall

Back Filling on Quay Wall, using Floating Crane and Basket Net of 16 cubic yards capacity per batch



Reinforced Concrete Cellular Block-making Yard

Concrete Block-making Yard

the quay wall slid out and overhung without falling into the water, as shown in Fig. 8, the restoration was carried out by using the cellular or hollow bottomless block type of quay wall. These blocks, weighing up to 50 tons each, are moulded on shore and loaded on lighters by means of a floating crane and carried to the site and placed in position by the crane. Their interiors are then filled with concrete and the vertical joints stiffened by concrete. The horizontal joints are stiffened by steel bars or old rails, in consequence, the wall when completed is one mass. The wall is fixed to the ground by concrete placed in front and back in order to guarantee stability.

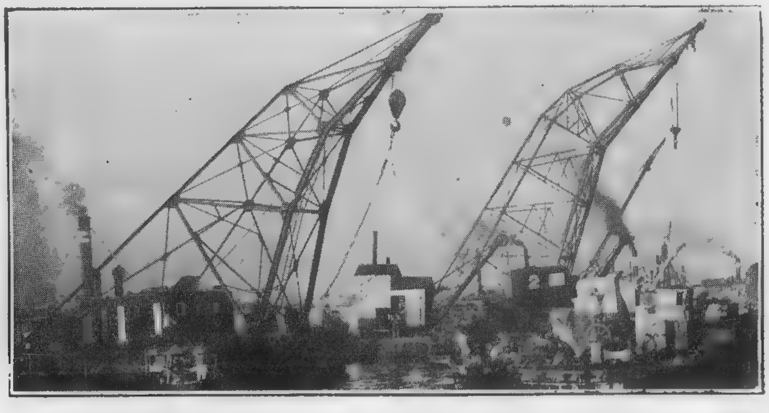
In further extension work to Yokohama Harbor the engineers will adopt the multiple arch caisson type quay wall as shown in Fig. 9. This design will be adapted for such sites where the bed is not so hard. The reinforced concrete caisson has a cylindrical wall whose horizontal section is a multiple arch. The water pressure on the outer surface will act normally on the wall and the resultant pressure line pass through the neutral axis of the arched wall. In consequence of this the water pressure on the wall in its floating stage will give a uniform compressive stress, causing no bending movement, with a consequent saving in reinforcing bars, thus permitting the wall itself to be made very thin. Only a small amount of steel is required to resist the internal stress of the concrete wall owing to its setting, shrinkage and temperature change; also against the expansive force of the filling material in the caisson. The depth of draught will be considerable under that of the rectangular type of caisson. The execution of the work is simplified and the cost of construction much cheaper. On the base of the caisson many longitudinal grooves are moulded in order to increase the friction when the space between the base and the foundation is filled with cement mortar by a grout mixer. The holes providing sluice valves in the base of the caisson will be used not only to fill the mortar, but also to pour water in the chamber when the caisson is required to be sunk in position.

Another type of quay wall that will be employed for rapid work in the extension of Yokohama harbor is what is known as the Pre-Cast Buttress Wall. The general plan of this type is shown in Fig. 10. The buttress wall sections, weighing 50 tons each, are

Reinforced Concrete Cellular Block (16-ft. × 16-ft. × 9-ft.) placed in position by Floating Crane

Laying Cellular Blocks in Site by a 50-ton Floating Crane

Digging up the old Concrete Blocks of Destroyed Quay Wall by a Dipper Dredge



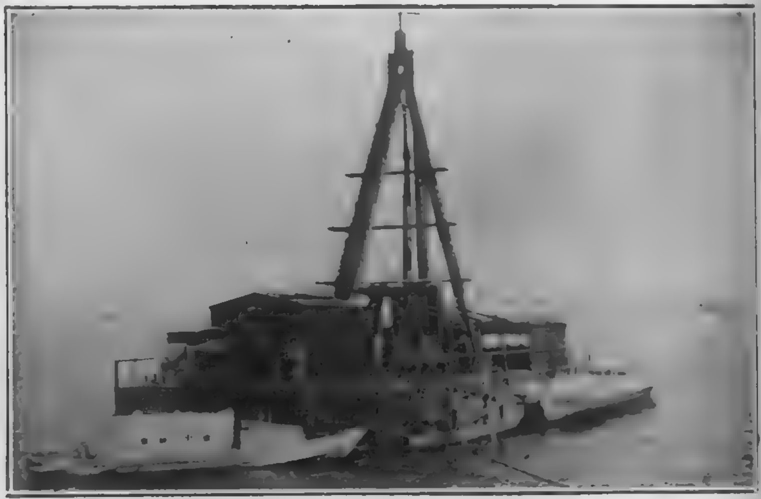
Using Old Concrete Blocks of Failed Quay Wall to make New Foundations moulded on shore and then placed in site by a floating crane and barge. Each wall will be fixed with cement mortar, which is filled in a canvas bag placed in the vertical groove. This type, if properly designed, can be made proof against ordinary earthquake shocks, and is very cheap when a floating crane of ample capacity is employed.

A general résumé of the work attached to the restoration of Yokohama harbor shows a great improvement over pre-quake facilities. Quays Nos. 4, 9, 10 and 11 have been lengthened 48-ft. each, adding 2,632 *tsubo* of reclaimed land to the area of the Customs compound. Before the quake, the cargo sheds were only 84-ft. wide. These have been rebuilt from 108 to 120-ft. wide, materially increasing the storage space. The depth of water has also been increased from 32 to 34-ft. by advancing the quay walls, the water depth alongside Quays 9, 10 and 11 having been increased from 24-28-ft. to 26-30-ft., permitting the largest steamers to dock.

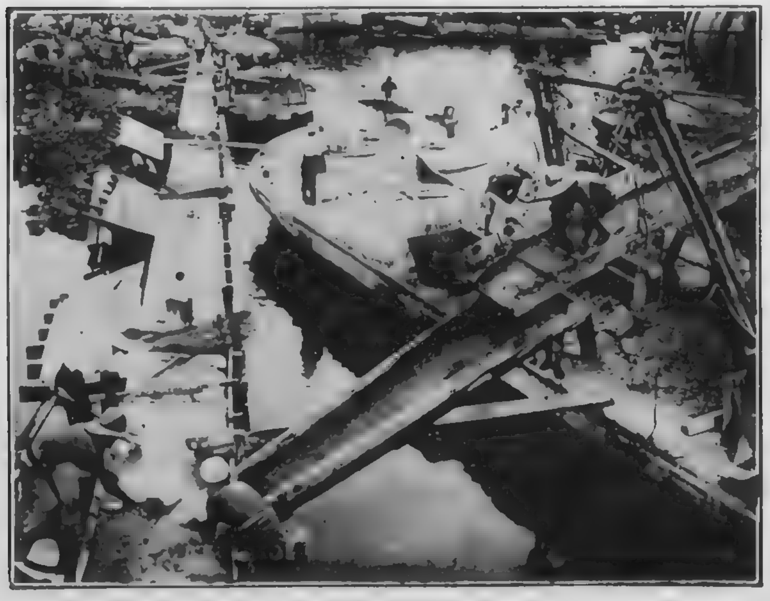
During the earthquake the entire breakwater sank an average of eight feet, the worst damage being at the east end, where 3,000-ft. fell, and at the north end to an extent of 1,580-ft. The foundations did not break or fall, and only

Repairing the Breakwater

American Dipper Dredge (6 cubic yards bucket) at work in Yokohama Harbor Restoration

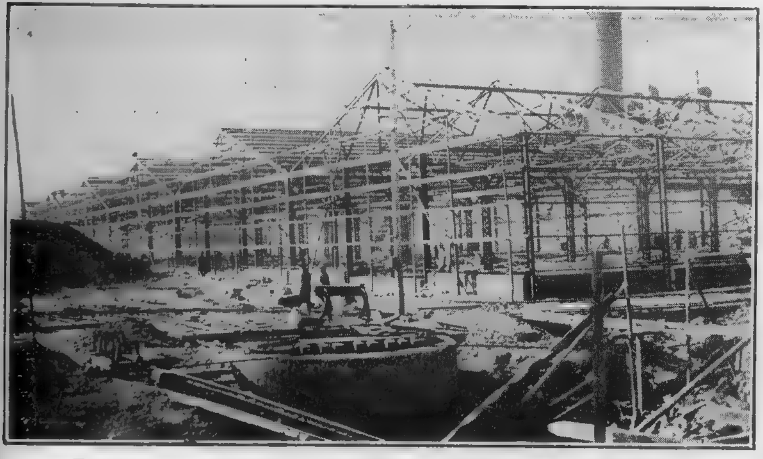


15-ton Rock Cutter made by Lobnitz & Co., Ltd., of Glasgow, on Reconstruction Work in Yokohama Harbor



Concreting of Barge Wharf

Priestman Dredger at work



Reconstruction Work on Customs Warehouses in Yokohama

where they were laid direct on the sea bottom did they sink. All the failed sections fell out toward the sea. Where square blocks were used the whole wall fell, but fortunately the greater part of the wall held, and repairs were confined to building a new wall on both sides of the fallen parts, filling in the space with concrete. The height of the repaired breakwater is now 8-ft. above low tide level and 15-ft. wide across the top. Much of the stone used in repairs came from the old quay walls. Work on the breakwater was commenced in November 1923 and carried on without a break until it was completed in 118 days.

The restoration of the quay walls and cargo sheds was commenced in December 1923 and entirely completed by the end of April 1925. In May 1924 the restoration of Quay No. 9 was completed, and in September of the same year it was possible to moor the Taiyo Maru, the largest steamer of the Toyo Kisen Kaisha, alongside. A brief outline of the damages and work on each quay follows:

No. 1 Quay: Only 318-ft. of this quay wall remained undamaged, but the slope had been increased to such an extent that the whole wall was condemned as dangerous, and completely rebuilt to the same plan.

No. 2 Quay: The upper courses of concrete blocks in this wall were thrown down into the water, and the entire wall must be rebuilt. A concrete foundation, 18-ft. high and 8-ft. wide, will be laid on the hard clay strata, and the support walls bound together with cement poured into place through canvas pipes.

The T. K. K. Steamer Taiyo Maru Moored at the New Quay Wall

No. 3 Quay: The original foundation for this quay wall remained intect and was employed for building the new wall. It was first necessary, however, to remove all the old blocks to clear the site for the new bottomless caisson type of wall, 442-ft. long.

No. 4 Quay: The same general type of reconstruction was followed in rebuilding No. 14 Quay wall, which was extended 38-ft. in length and 8-ft. in width. It is now 684-ft. long. As shown in Fig. 11, an entirely new wall was erected. The fallen blocks were realigned so as to form part of the new foundation, a new outer footing laid, and the caissons plared on this foundation. These caissons, ten in number, 51-ft. long, 16-ft. wide and 24-ft. high, weighing 430 tons each, were built in the drydocks of the Asano Shipbuilding Company at Tsurumi, floated out and towed to site. Bottomless caissons, weighing 27 tons each built at the concrete yard operated by the Harbor authorities, were also used in the reconstruction of this pier. The space between the new and old quay walls has been filled in with earth, in all 4,380 cubic *tsubo*.

No. 5 Quay: Will be rebuilt like No. 3 and lengthened 48-ft., using the old foundation.

No. 6 Quay: The wall of this quay was shifted 6-feet, the second and third course of stone being forced out and thrown down. Repairs have followed the same lines as those for No. 3.

Nos. 7 and 8 Quays: The old foundations had to be cleared away and the repairs made the same as No. 3.

Nos. 9, 10, 11 Quays: These three quays were completely wrecked and have been entirely rebuilt. To prepare the foundations the enormous blocks of the old wall, weighing 160 tons, had to be broken and removed. The sand and rubble was then dredged to the hard clay strata on which the caissons rested. On these were laid the steel beams to support the floor of the new piers. These piers have been extended 48-ft. in length, increasing the depth of water alongside at low tide to 26-30-ft. The details of this work are clearly shown in Fig. 7.

No. 12 Quay: In restoring this pier it has been lengthened 60-ft. The broken wall was not disturbed, but the bottom was dredged to the hard clay strata and the old stones used for the foundation, on which caissons were placed and the concrete super-structure erected

No. 13 Quay: This quay is only used for lighters, and very little changes have been necessary

In addition to the extensive damages to piers and warehouses, all the shore landing places and protection embankments (buildings) were completely destroyed. To date about 5,000-ft. of bunding has been repaired. Both bridges on the new harbor compound were badly damaged. The steel superstructures remain, but

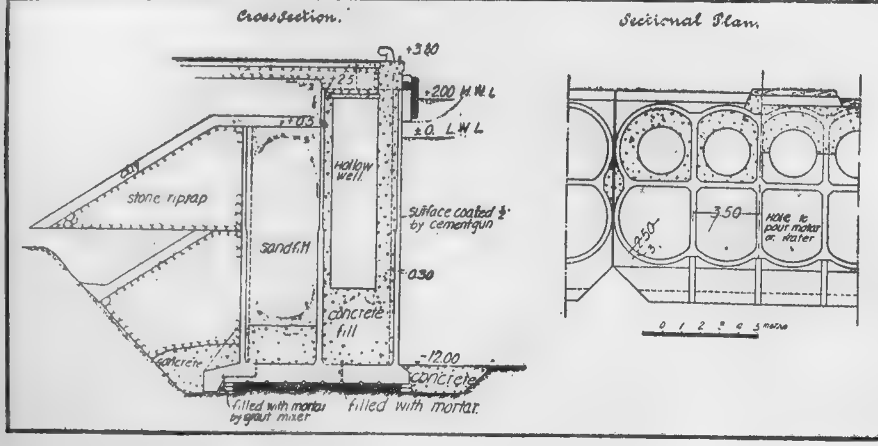


Fig. 9: Multiple Arched Caisson Type of Quay Wall to be used in Future Extension Work of Yokohama Harbor

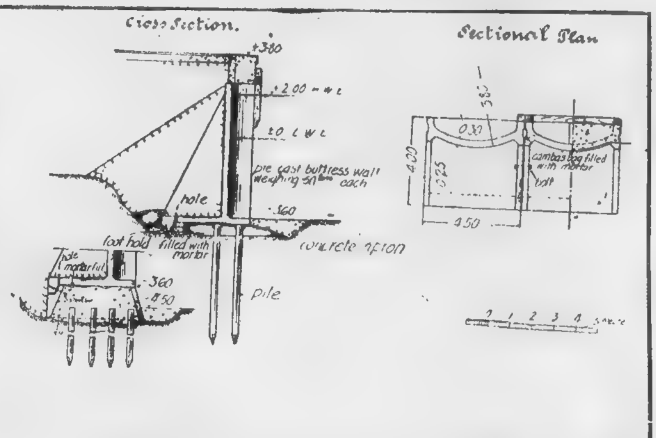
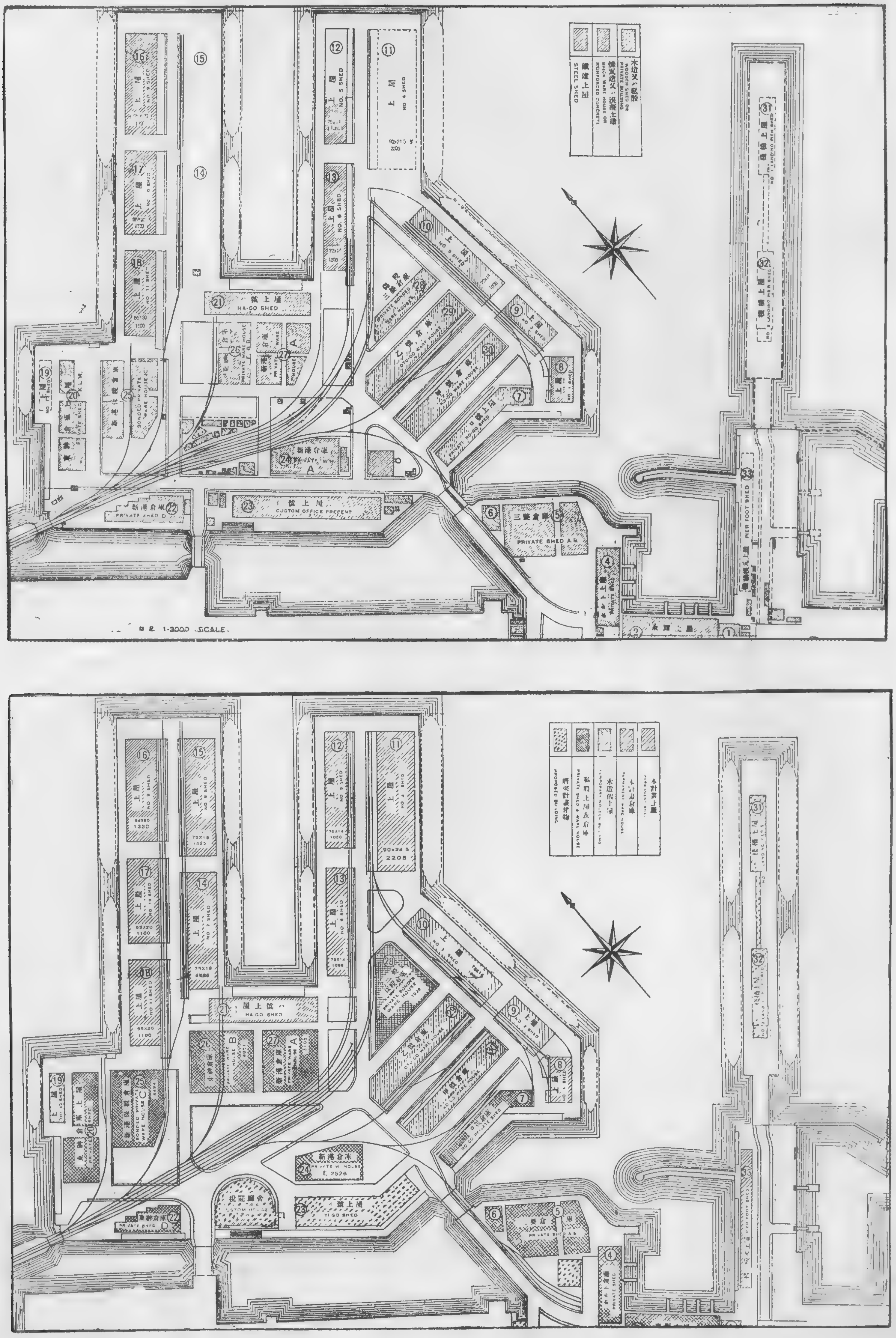


Fig. 10: Pre-Cast Buttress Wall used in Minor Wharf Construction in Yokohama



Plans Showing Present (Top) and Proposed Future (Bottom) Accommodations of Yokohama Customs Compound

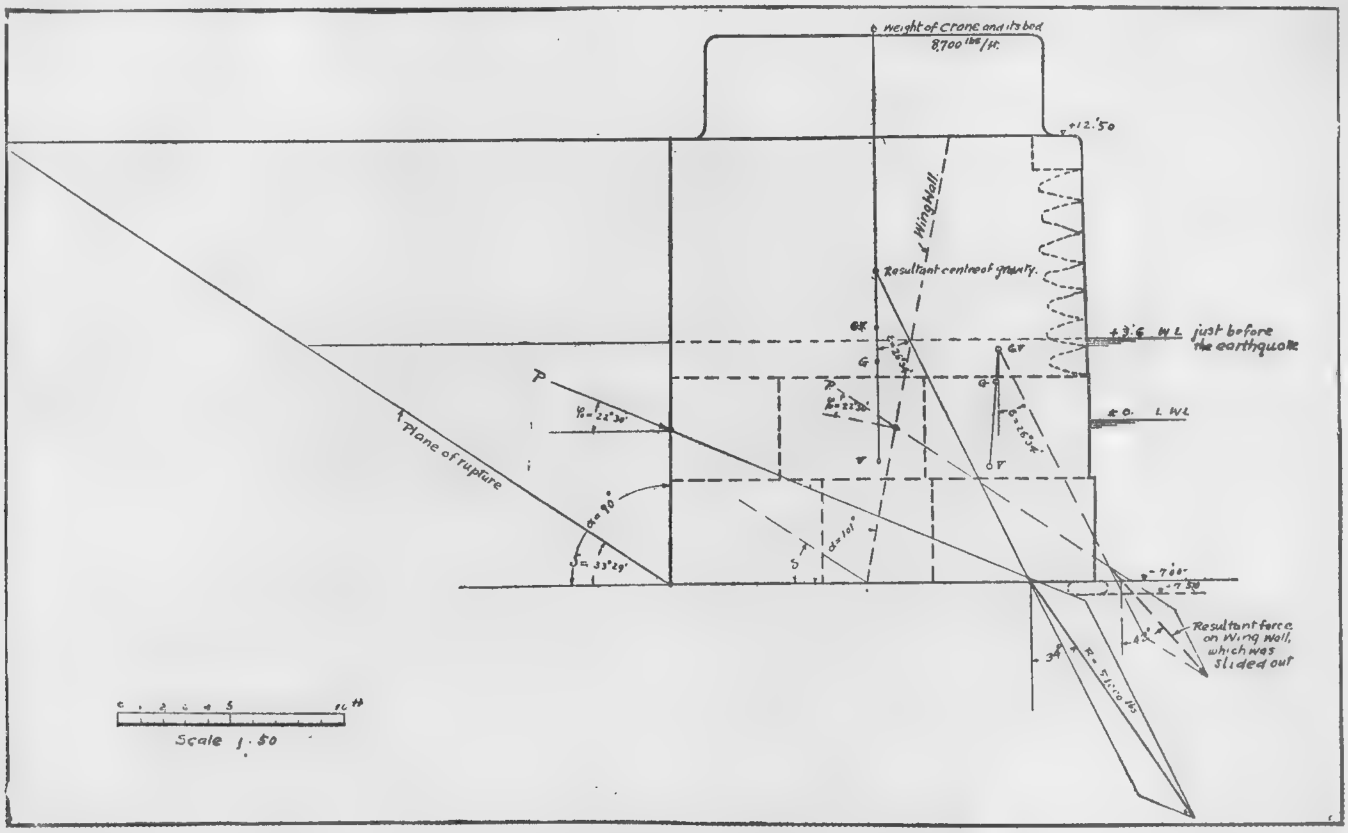

Weight of crane and its bed 8,700 lbs/ft.
+12.'50
Wing Wall.
Resultant centre of gravity.
+3.'6 W.L. just before the earthquake
± 0. L.W.L
G
GT
P
φ₀ = 22°30'
Plane of rupture
α = 90°
δ = 33°29'
α = 101°
δ
-7.'00
-7.'50
Resultant force on Wing Wall, which was slided out
42°
34°
R = 51,000 lbs
0 1 2 3 4 5 10 ft
Scale 1 : 50

Fig. 5: Force Diagram for the Stability of Crane Base.

the pier foundations shifted. These were finally repaired in July 1924.

One of the greatest dangers to navigation was the large number of lighters and launches with their cargoes which were burnt during the conflagration and whose haulks littered the channel and harbor bottom. By May 1924, 348 sunken lighters and 79 other vessels, besides an enormous amount of cargo and other materials, had been dredged up, and 1,200,000 *tsubo* of bottom cleaned.

The equipment of the Harbor Board fared the same general fate as other property, the engineers facing the job of reconstruction with only 30 lighters, 5 Priestman dredges, 7 small launches and 2 concrete mixers. Since then three floating cranes, two additional Priestman dredges, one American dipper dredge, the Lobnitz rock cutter, five huge concrete mixers, one launch and 33 lighters have been acquired.

The cost of restoring Yokohama harbor to date has been Y.16,000,000, of which Y. 4,600,000 was expended on machinery, materials and labor on the quays alone.

Much has been done, but much more remains to be done. The docks are sewed by ten miles of railways which are still unusable owing to the repair work going ahead. Nineteen electric and three steam cranes must be replaced and many other refinements of transportation and cargo handling installed.

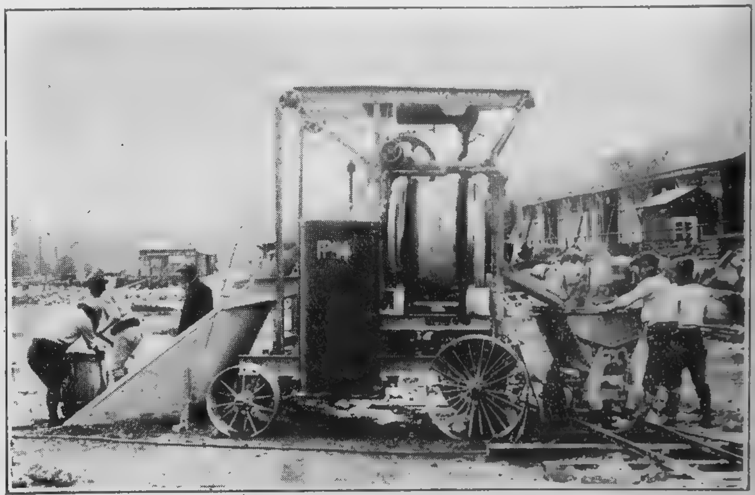
The work of the harbor engineers has re-established the port of Yokohama as the gateway to Tokyo and assured its place as the premier foreign trade center of the empire. The latest figures show that the total import and export trade of Yokohama for the period between May to December 1924 was Y.893,257,000 against pre-earthquake figures (September 1922 to April 1923) of Y.988,689,000. But this is only the beginning of a development plan that is destined to elevate Yokohama into the premier port of the Far East.

All the buildings in the Yokohama Customs compound were either shaken to pieces by the earthquake or burned down in the fire, but by the end of March 1925, with the exception of some of the warehouse facilities, the entire equipment was about as it was before the disaster. Half of the quay warehouses had been restored, and all roads and bridges and drainage equipment were completely rebuilt. Temporary buildings, however, to tide over until permanent structures could be erected, now house the Customs officers.

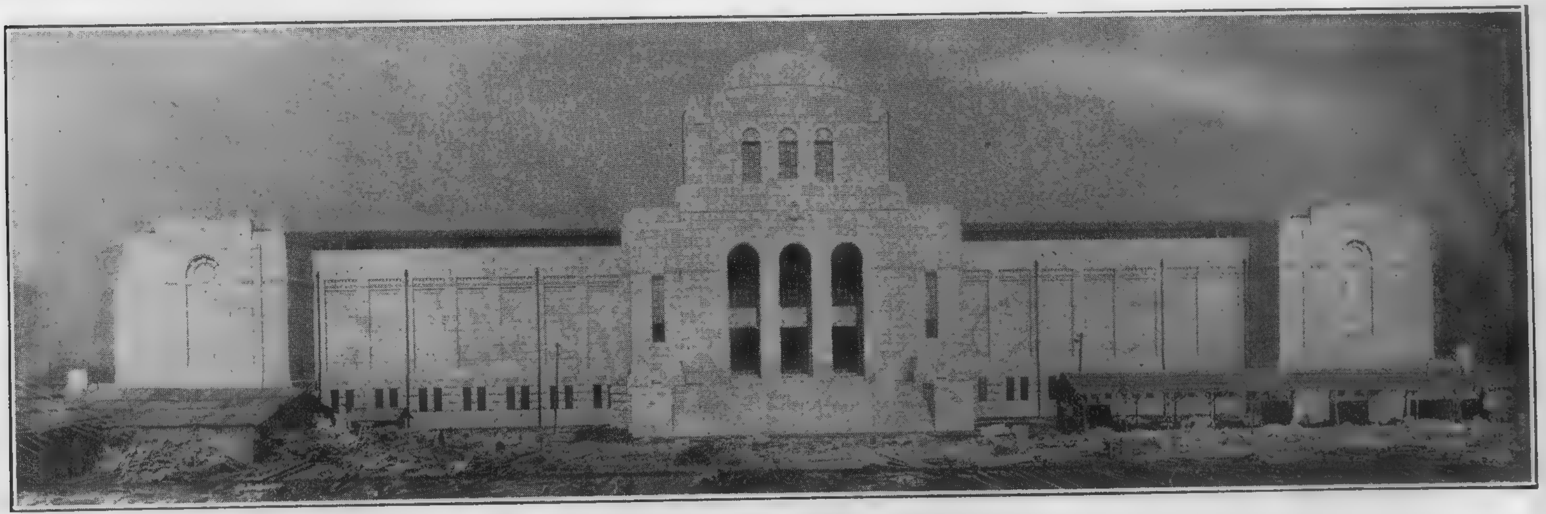
All the travelling cranes on the wharves at the time of the earthquake fell over, the 50-ton fixed cranes being broken and rendered useless. The power plant was wrecked, and more than 3,000 lighters moored within the compound were burned. It was impossible after the earthquake to land cargo direct from steamers.

The Customs House equipment is under the jurisdiction of the Department of Finance, while the Department of Home Affairs has charge of the Harbor Works. In 1923-1924 the Department of Finance spent Y.600,000 on necessary repairs to the compound, and the Diet appropriated in July last Y.5,285,000, to be expended over the period 1924-1928, on repairs and improvements to the Customs House equipment in Yokohama.

The steel frame warehouses, although damaged in the earthquake, have all been repaired without great difficulty and expense, so it has been decided to build all new warehouses entirely of steel and iron sheets. The power plant will soon be operating again.



Koehring 7 cubic feet Paver, Used by Reconstruction Bureau in Imperial Palace Grounds.



Art Gallery and Museum in Meiji Park, Erected by the Okura Building Co., Ltd.

In Memory of A Beloved Ruler

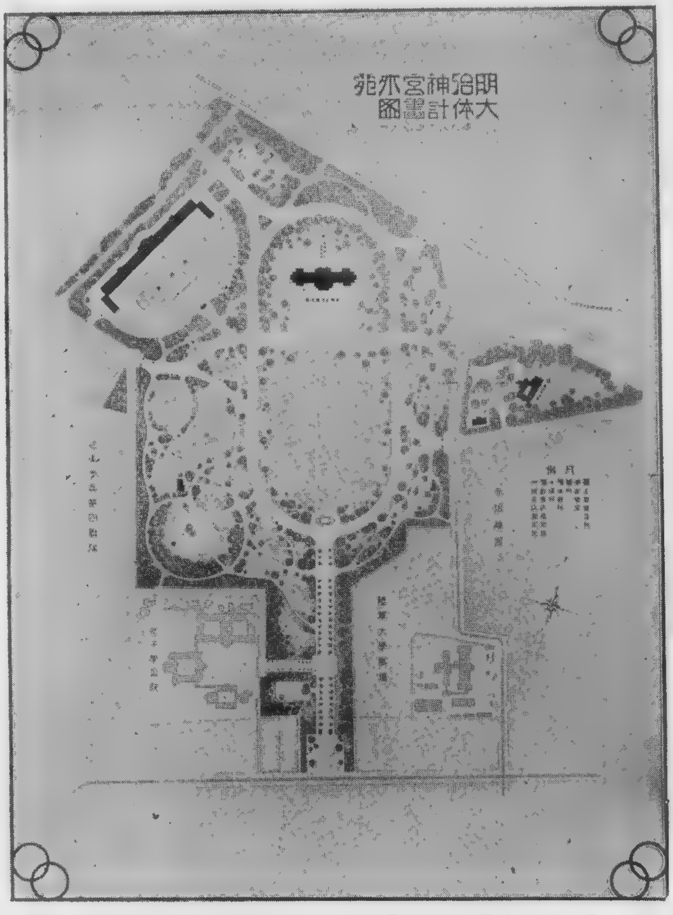
The Beautiful Memorial Park of Emperor Meiji the Great

THE Emperor Meiji is dearly enshrined in the hearts of the Japanese and revered by his people to a greater degree than any ruler of modern times. Under his guidance Japan rose from the obscurity of feudalism to one of the first Great Powers of the world, due in great part to the wise and benevolent statemanship of this paternal sovereign. He is spiritually sanctified in the solemn and simple grandeur of the Meiji Shrine, completed some time ago, but as a further memorial to his greatness, and as a mark of especial esteem on the part of the Japanese, it was decided to erect a magnificent piece of work in which all his subjects should share as a permanent monument to the Emperor Meiji the Great.

The plans for this great public work includes a large tract of land adjoining the grounds of the Meiji Shrine, which will be made into a huge park with suitable buildings of both practical and æsthetic value as typifying the great industrial growth of the empire under his rule and at the same time emphasize the moral and artistic progress made during the era of Meiji. The buildings are to be a hall to commemorate the establishment of the Constitution, to be known as the Kempo Kinen Kan; another building as a tribute to the virtues of the Emperor Meiji, which will be called the Seitoku Kinen Kan; a large art gallery and museum, an athletic field and a special building to perpetuate the memory of the structure built in the parade ground in 1912 from which the body of the Emperor was borne to its final resting-place in the Imperial mausoleum at Momoyama.

This memorial is to be built from funds which were given by Japanese from every walk of life. The land is an Imperial grant given the memorial in 1916. The plans were completed and actual construction work begun in February 1917 and the whole was to have been finished in 1924. The buildings under construction were undamaged by the earthquake, but work was delayed. The grounds were thrown open to refugees and barracks erected for their use, which further hindered the progress of construction.

In spite of these handicaps the beautiful art gallery and the athletic grounds and stadium were completed in October 1924, and work on the Seitoku Kinen Kan is practically finished at the present time. The art gallery is one of the most beautiful buildings in Japan built in the western style of architecture, as are all the other structures in this memorial, although pure Japanese Shinto architecture characterizes the buildings of the Meiji Shrine nearby. The majesty and dignity of the art gallery are indeed a fitting tribute to the great Emperor.

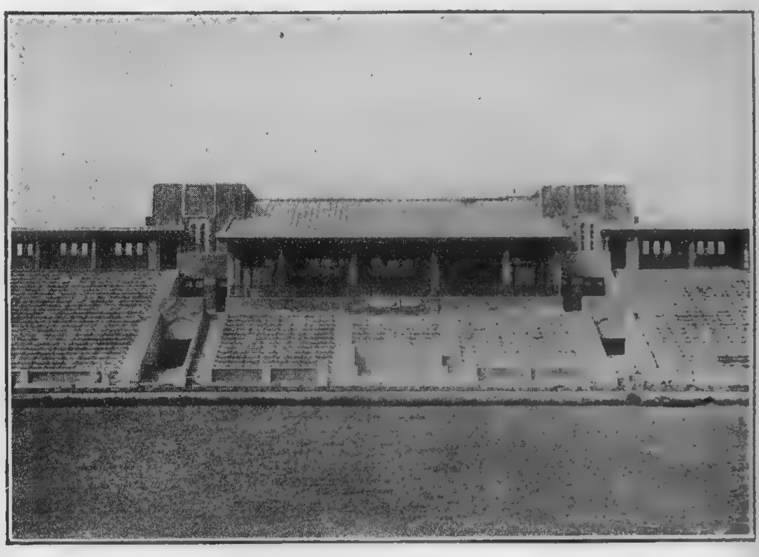


General Plan of the Meiji Shrine Park in Tokyo, with Art Gallery as Central Figure and Stadium to the Left.

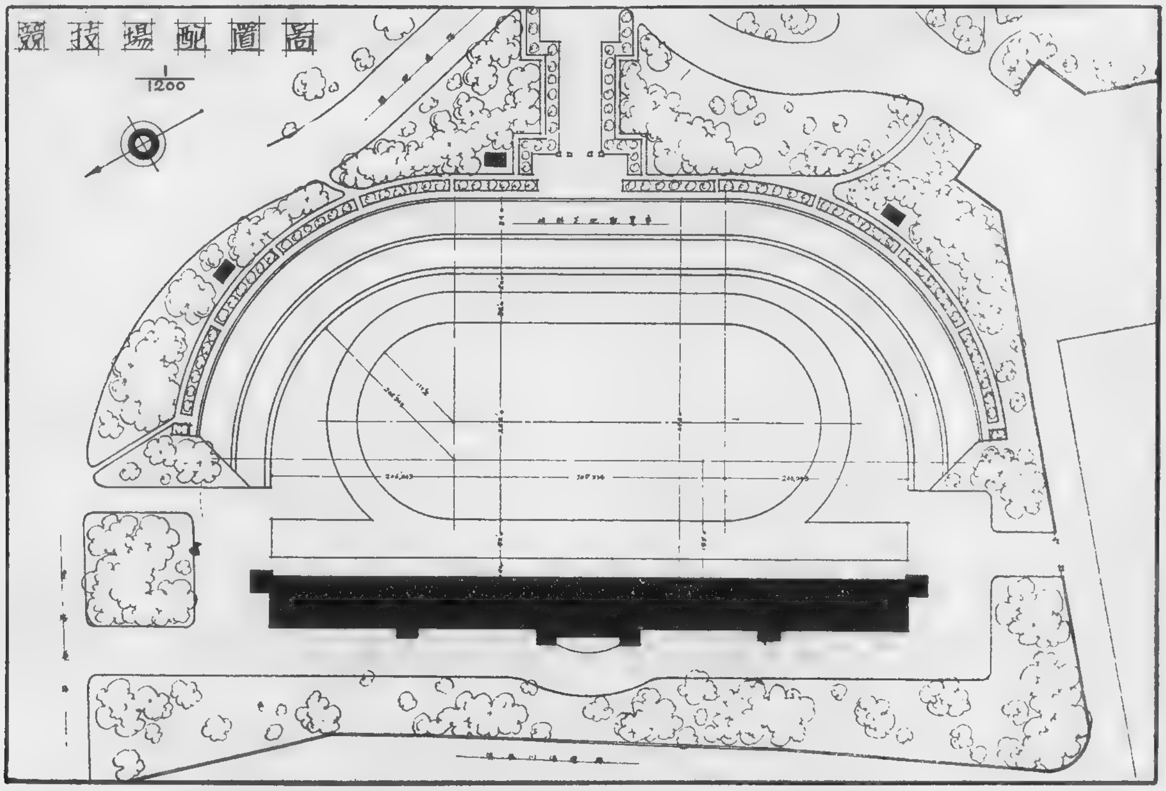
In keeping with the spirit of the Meiji Era, which means the Era of Enlightenment, the finest athletic field and stadium in the Far East was made a part of the Meiji Memorial. Here the youth of Japan may show their progress in healthful physical competition and develop a hardy and strong manhood as the Emperor would have wished. The stadium covers an area of 360,000 square feet, while the field has an area of 2,980 *tsubo*, with 941 *tsubo* of stands and 2,770 *tsubo* in terraced turf bleachers. The outside track is an oval 400 meters in length. The cost of this project alone amounted to Y.1,053,000.

All the stands and buildings are of reinforced concrete, the main grand stand being 60-ft. wide and 768-ft. long. There are twenty-six tiers of seats accommodating 20,000 people, while the terraced bleachers, built up in the form of a bowl, will accommodate 50,000 more, a total seating capacity of 70,000 people, which compares favorably with any of the stadiums in the United States or Europe. Under the central part of the grand stand are locker and dressing rooms, two bath rooms,

Rear View of West Stadium Stand



Grand Stand of Stadium

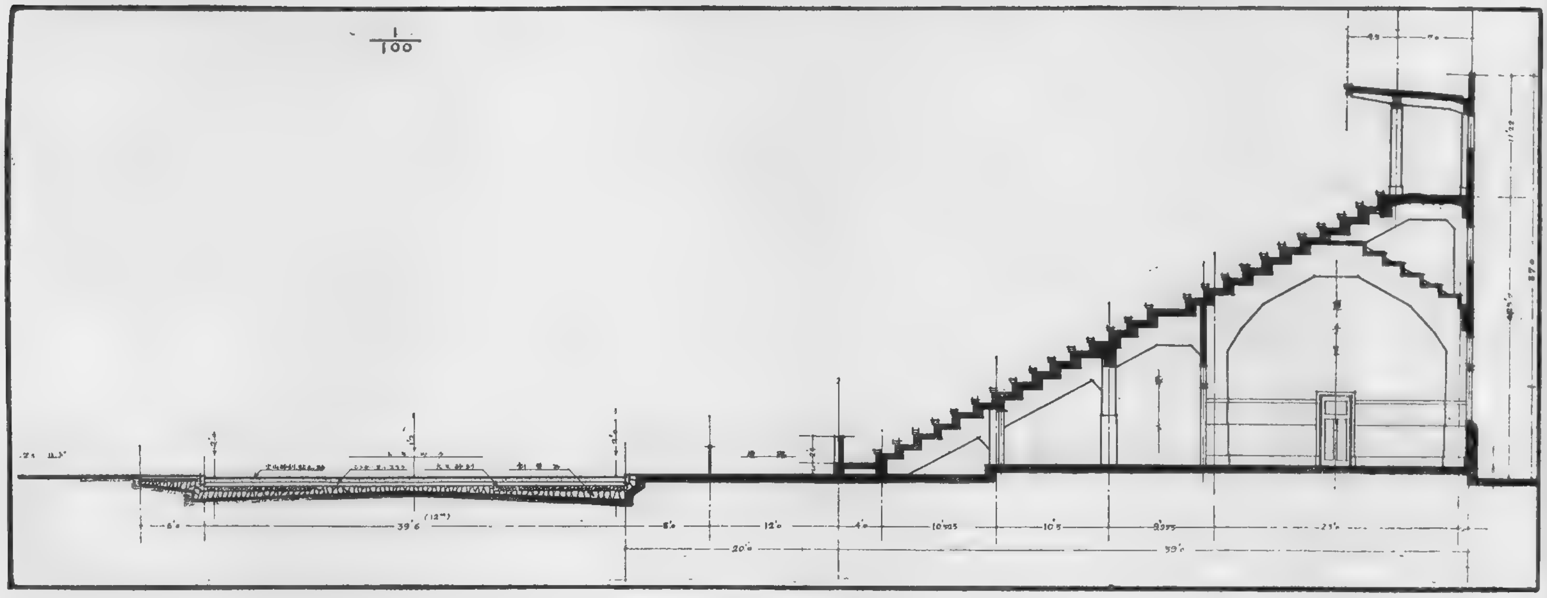


General Plan of Stadium Grounds

Gymnasium and Dining Hall under the Stadium Stand four training rooms for rub-downs and massage, and a large dining room. Special facilities are provided for every kind of popular sport, such as baseball, football, cricket, tennis and track meets. With this field Japan is provided with suitable equipment to stage the International Olympic Games when it is her turn to do so.

The large grounds of the memorial will be made into a spacious park, planted with all kinds of native trees and shrubbery. Wide paved roads and concrete sidewalks connect the various buildings, which, together with a beautiful approach avenue lined with Icho trees, will make a most pleasing *ensemble.* Thus one of the beauty spots of the empire is the permanent memorial to the beloved Emperor Meiji and to the spirit of progress in the Japanese people of which he was the sponsor.

Grand Stand and Oval at the Meiji Shrine Stadium



Elevation of Stadium Stand

O.S.K. To Raise Loan of Y.20,000,000

To Open Route Between Dairen and Hongkong with Eight New Steamers.

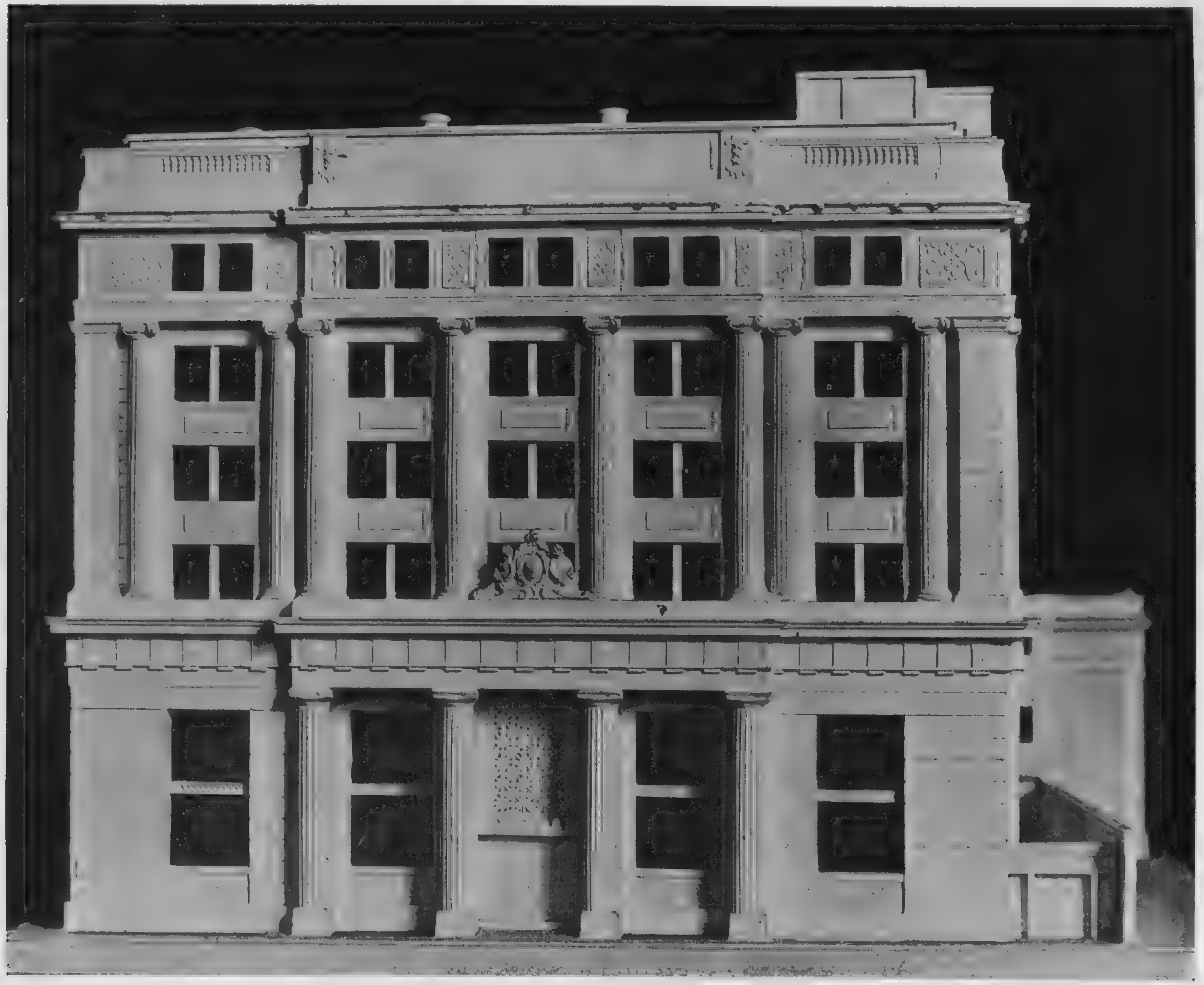
THE Osaka Shosen Kaisha recently announced its plans to float another debenture issue of Y.20,000,000, partially to convert a previous issue which is about to mature, and more particularly to improve its service on routes in China. This plan is to come up for approval at the semi-annual general meeting of the shareholders on July 27. Preliminary negotiations have already been made with the Sumitomo Bank for the acceptance of the new debentures.

A part of the funds are to be used to meet payments on the ninth debentures, the term of which expires on September 1 next year. The remainder will be devoted to inaugurating a service between Hongkong and Dairen, via Shanghai. This plan was adopted following a report made by Mr. Murata, the managing director of the company, who made a trip to China to investigate the conditions. For the new China coastal service the company will have seven or eight steamers, each displacing about 2,500 tons.

Despite the prevailing depression, the Osaka Shosen Kaisha netted profits totaling Y.1,511,000 in the first half of this year on which the company is to declare a dividend of 7 per cent. The business of the company was specially favorable during the first three months of the past term, according to the report. Due to the depression in the foreign trade, and more recently because of the strike in China, the favorable returns fell off towards the end of the term, and the company is being forced to use Y.700,000 out of its reserve funds in order to pay out the 7 per cent. dividend.

The balance sheet of the company during the first half of 1925, in units of Y.1,000, follows:

Total	Y.31,718	Y.28,120
Total expenditure	25,617	22,370
Profits	6,101	2,750
Reserve funds	4,590	4,590
Net profits	1,511	1,160
Balance brought in	86	114
Reserve funds disposed for dividends	700	1,000
Dividend (7 per cent.)	2,187	2,187
Balance forward	110	86

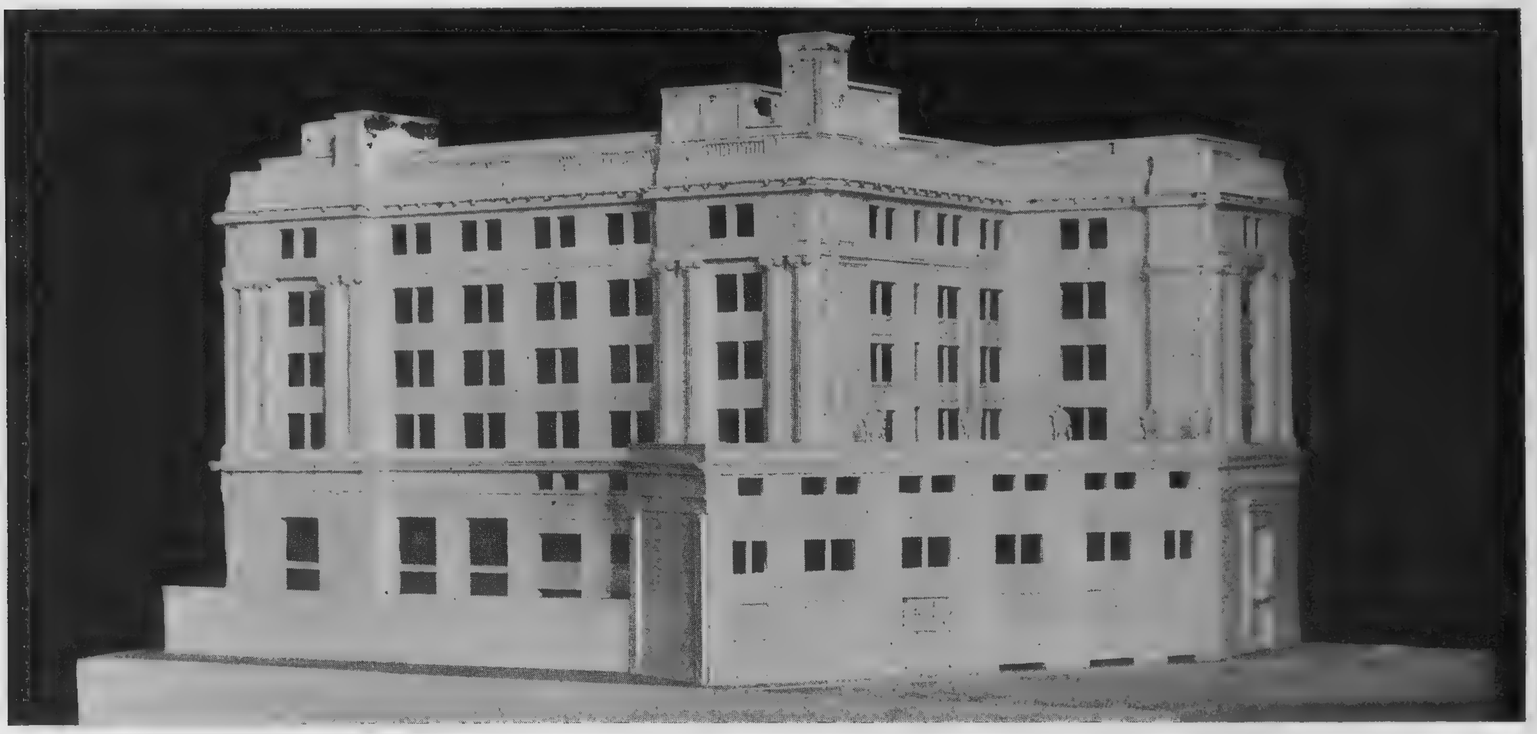


Front View of the New Yokohama Specie Bank Building at Tokyo from Architect's Model

The Palatial Executive Office of the Yokohama Specie Bank at Tokyo

ONE of the most artistic of the many new and handsome bank buildings in the financial district of Tokyo is the magnificent structure now in process of erection for the Yokohama Specie Bank, one of the strongest and most widely known monetary institutions of Japan. Since its foundation in 1880, the head-office of the bank has been located in Yokohama, but with the development of the capital into the financial and commercial centre of the empire, the Tokyo branch together with the Executive Office of the bank gradually assumed a greater importance than the head-office at Yokohama. Commencing with a modest capital of Y.3,000,000 for the purpose of encouraging and financing Japan's foreign trade, the Yokohama Specie Bank has increased its capital from time to time to cope with the constantly expanding trade of the empire, until to-day it has a paid up capital of Y.100,000,000 and a reserve fund of Y.80,500,000. More than half of the foreign bills of exchange, representing an equal proportion of Japan's import and export trade, are handled by this bank whose forty branches and more than five hundred correspondents cover every important city in the world.

The old Japanese style building which housed the Tokyo branch for many years became totally inadequate to handle its growing business, so the directors decided to erect a modern edifice equipped throughout with the most approved and up-to-date conveniences. The drafting of the plans was entrusted to Mr. U. Nagano, a well-known Japanese architect, who designed a steel framed, reinforced concrete and granite faced building in the Greco-Roman style of architecture. The building is six stories above and two

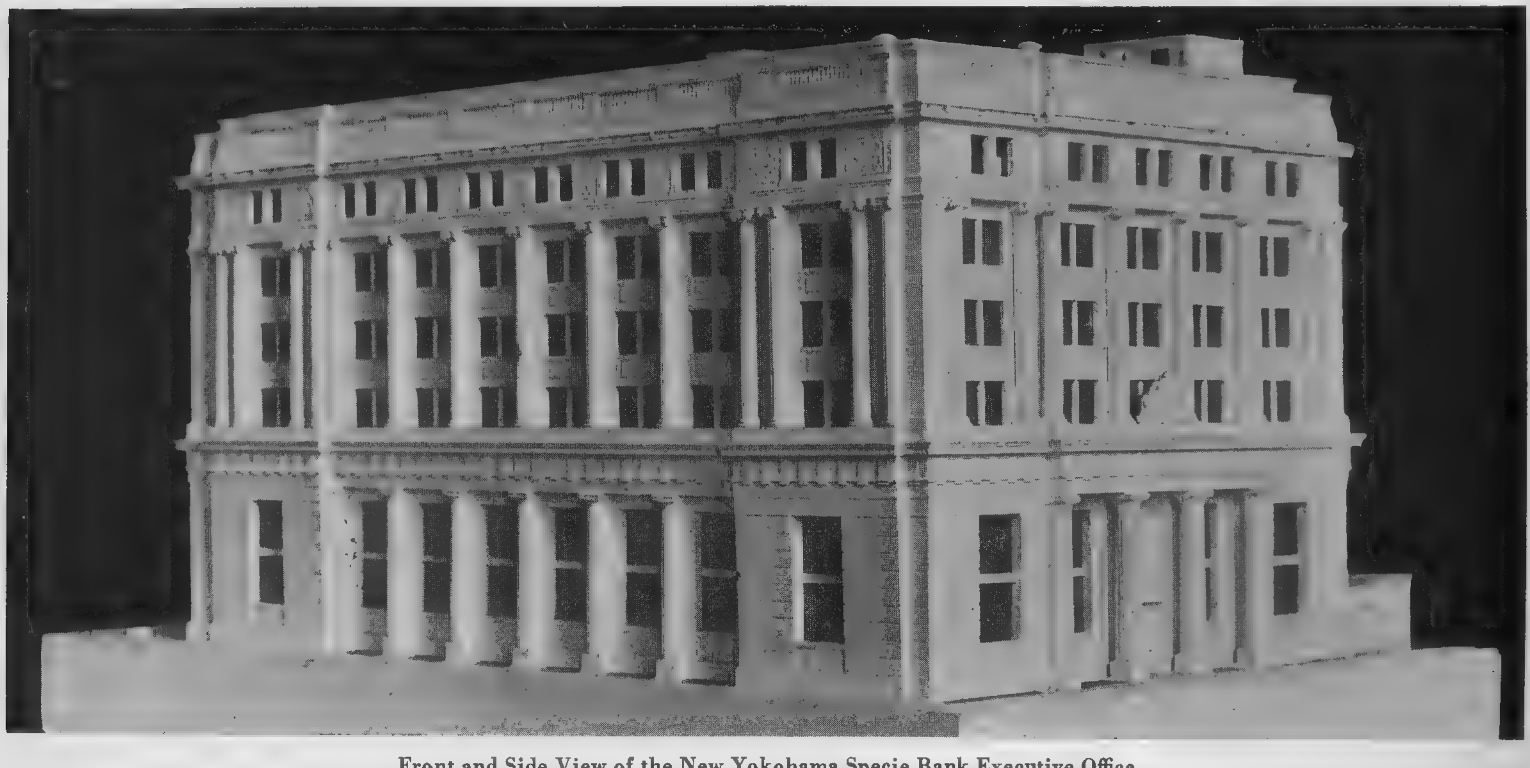


Rear View of the New Yokohama Specie Bank Executive Office

stories underground, having a ground area of 676 *tsubo* and a total of 5,013 *tsubo* of floor space. The height from the street level to the cornice is 102-ft., and 117-ft. to the highest point. This is the first building to be constructed in Tokyo with more than one underground story in order to provide ample space for safe deposit vaults for various purposes.

Owing to the nature of the soil in the Nihonbashi district, the foundation work was exceptionally difficult. Before work could be started, it was necessary to dig a wide trench around the site and build a concrete retaining wall to protect the main excavation from flood water and caving in. After completing this retaining wall, the main excavation was carried down to bedrock by means of mechanical excavators. The total excavation was 4,358 cubic feet, and 1,268 cubic feet of concrete and 163 tons of steel were used in the foundations. The contractor for the foundation work was the Kashima Gumi.

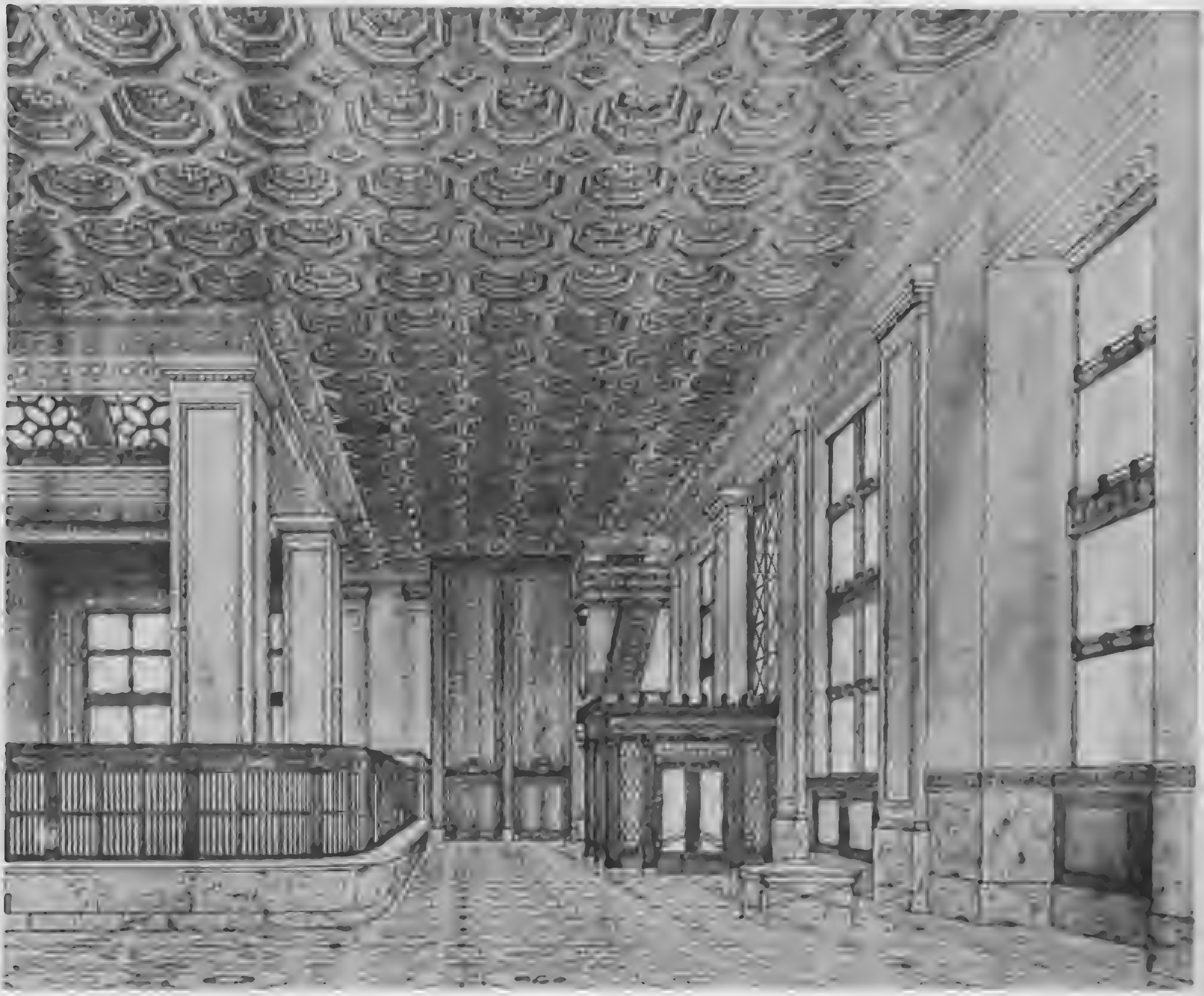
The steel frame and all iron used in the construction of the building (3,127 tons) was supplied by the United States Steel Corporation and erected by the Okura Engineering Co., Ltd. Every part of the steel frame is encased in fire-proof ferro-concrete and all floors, main walls and partitions are of the same construction. The outer facing of the building and the columns is of Kita-Kishima



Front and Side View of the New Yokohama Specie Bank Executive Office granite, an exceptionally fine building stone which was also used in facing the new home of the Yokohama Specie Bank in Shanghai. For cutting and working this stone a special plant comprising five cutters, surfacers and seven drills operated by two air compressors (50 and 35 h.p. respectively) was purchased from the Trow & Holden Company of America. The illustrations on page 453 show the compressed air drills, surfacers and cutters in operation at the quarry and the method of transporting and unloading the stone from the barges at the building site. The masonry contract has been carried out by the Kashiwagi Gumi.

of which, 11,756 square feet are from the Henry Hope Company, Ltd., of England and 5,834 square feet of Japanese make. As an extra protection against fire reaching the building from the outside during a general conflagration, rolling iron shutters will be fitted to 92 places.

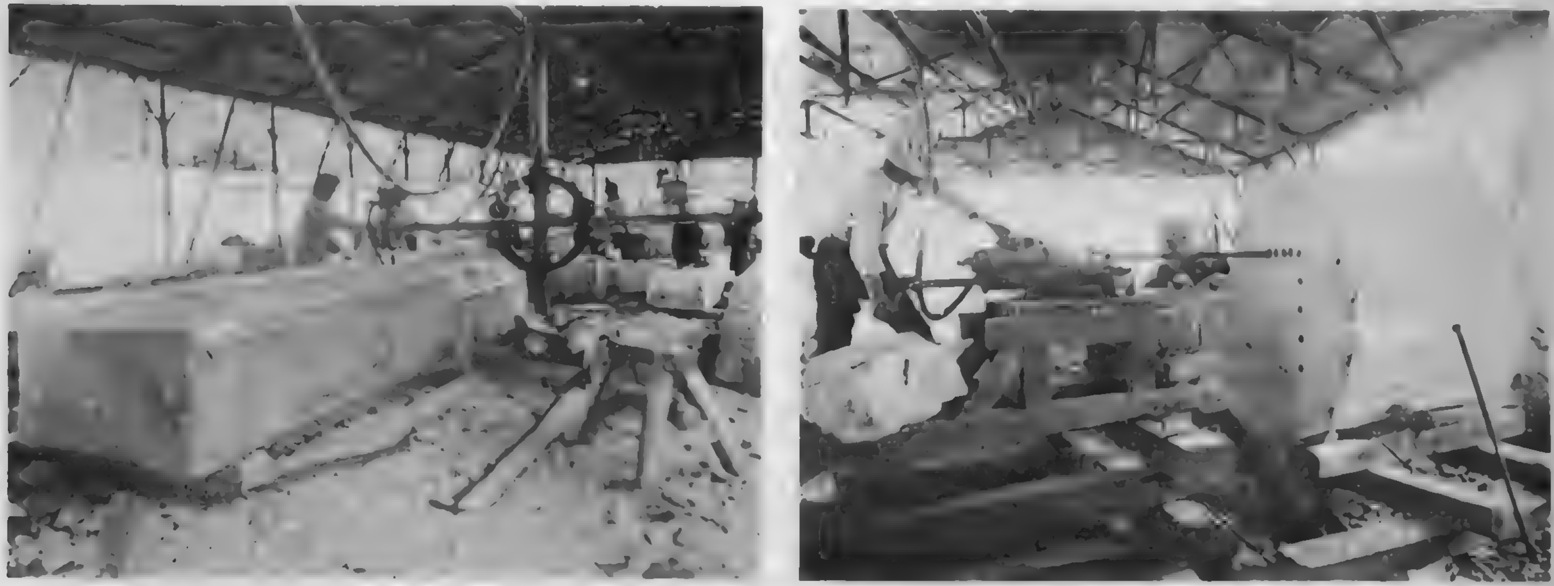
Foreign style plumbing with flush toilets, hot and cold water, wash rooms and lavatories of Japanese ware will be installed on every floor. The contract for this work together with the electric wiring and fittings, interior finish, and the vault doors and safety deposit boxes has not yet been awarded.



The New Yokohama Specie Bank Tokyo Branch Office: Detail of the Banking Floor from Architect's Drawing

All construction work is being carried out by sub-contractors under the direct supervision of the architect. The reinforced steel material has been furnished by the Truscon Steel Company, of Japan. The four elevators are from the A. B. See Elevator Company. The American Radiator Company, through their agents, (Takata & Company) have the contract for heating and also a ventilating system which will serve the main banking room and the underground floors. Windows will be fitted with steel sash,

Work on the building was commenced in October, 1920 and considerable progress had been made when the earthquake and fire devastated the city and the immediate district surrounding the bank building. This compelled a suspension of operations for ten months during which time a careful study was made of the effect of the quake on other modern steel frame structures. The unprecedented violence and severity of the shocks compelled a readjustment of accepted ideas of earthquake proof construction, enabling



Compressed Air Stone Cutters and Drills Shaping the Pillars

Fine Cutter for Curving

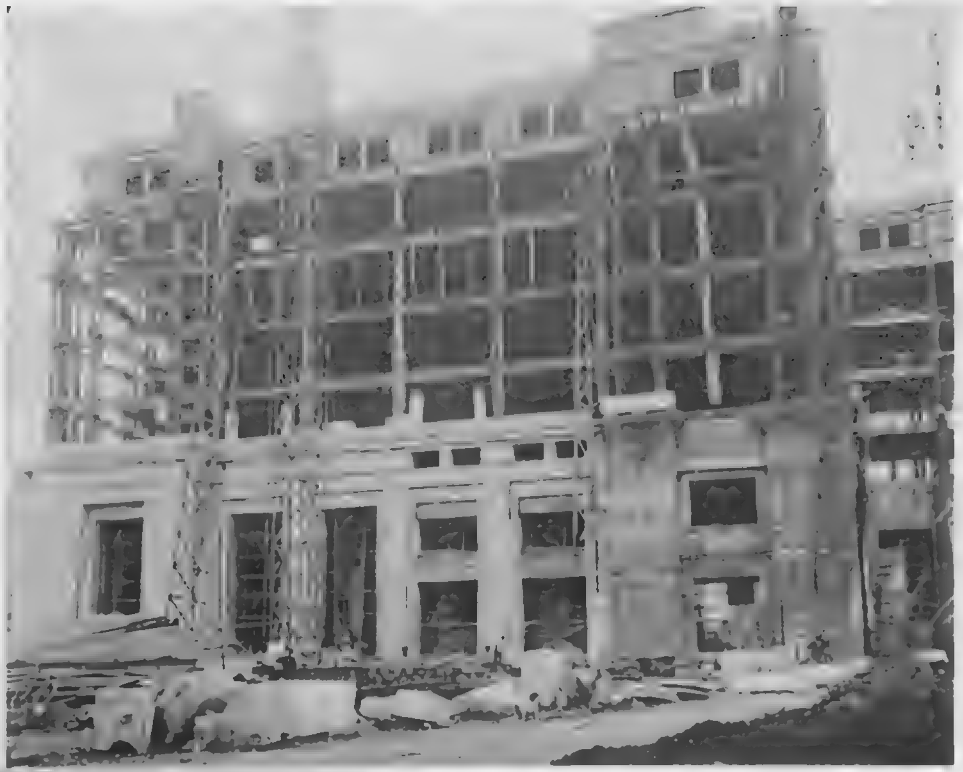
Loading the Stone on Barges at the Quarry

Unloading Stone at the Building Site

The Architect, Mr. Nagano

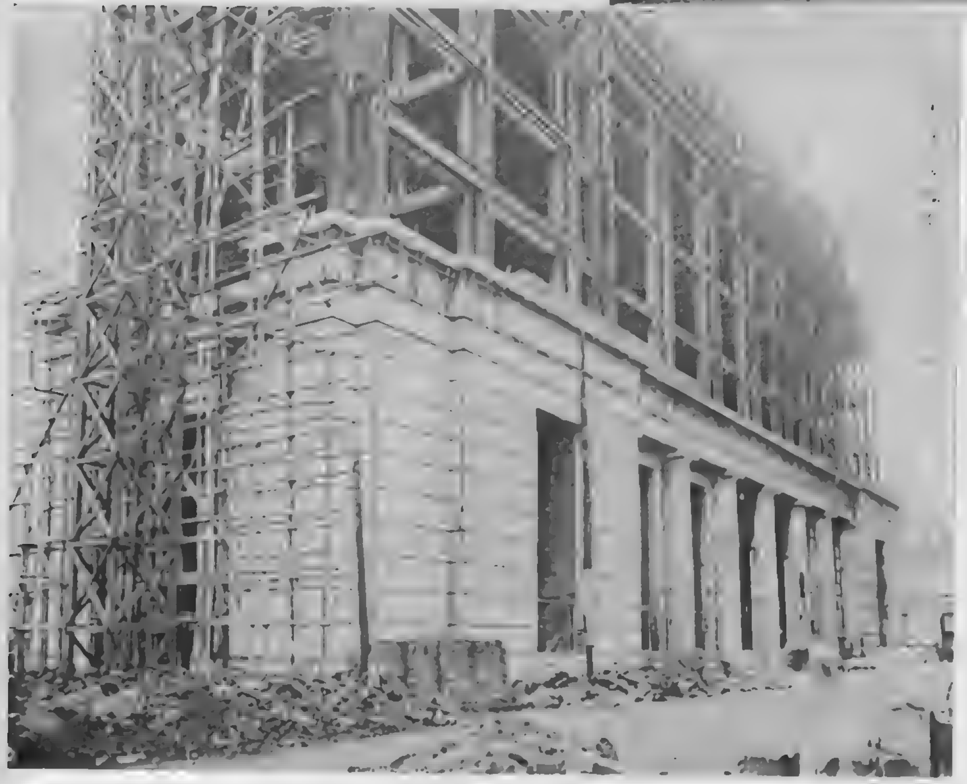
CUTTING THE DIMENSION STONE FOR THE NEW YOKOHAMA SPECIE BANK BUILDING

A Special Stone Cutting Plant Operated by Compressed Air was Imported from America to Facilitate Cutting the Hard Granite used in Construction the architect of the Yokohama Specie Bank building to adopt designs and precautions that provide an even greater measure of structural stability with a consequent added protection for the lives of the occupants of the building and safe keeping of the books and securities in the deposit vaults.

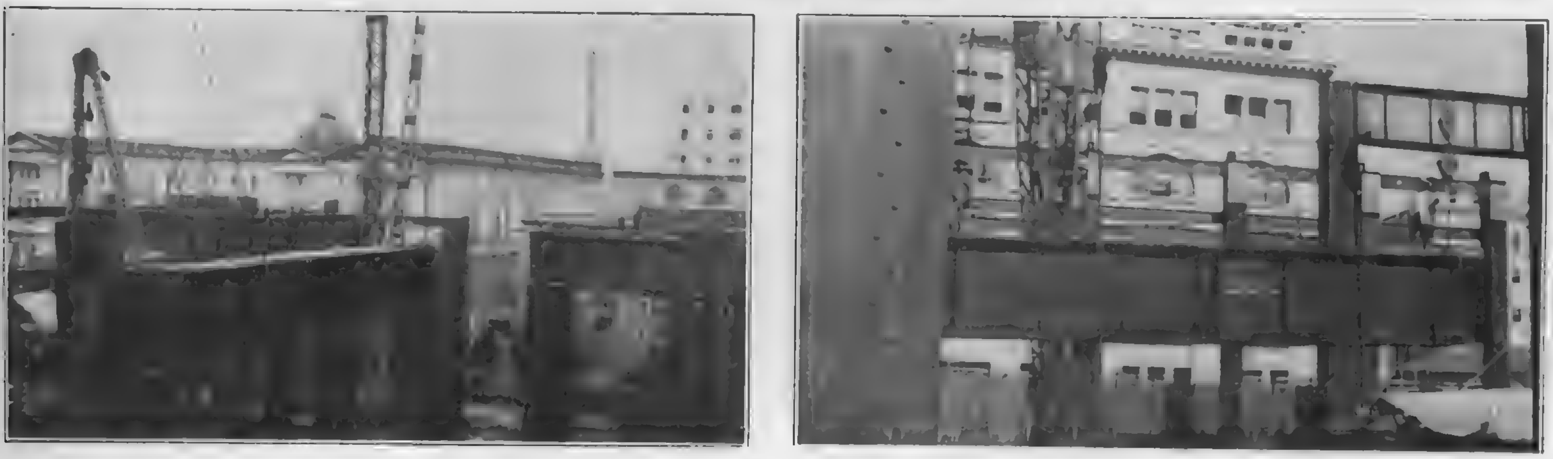


New Yokohama Specie Bank Building in Process of Erection. All the Steel Work was furnished by the United States Steel Products Company

As a result of these observations, all the exterior piers around steel columns, interior columns and connecting girders are entirely covered with concrete thoroughly reinforced around and through the columns and longitudinally. Solid reinforced concrete walls are built between columns and around elevator shafts, stair wells, pipe and vent shafts. Owing to these additions to the original plans, the estimated cost of the building (Y.6,000,000) has been increased by Y.800,000, making a total of Y.6,800,000.



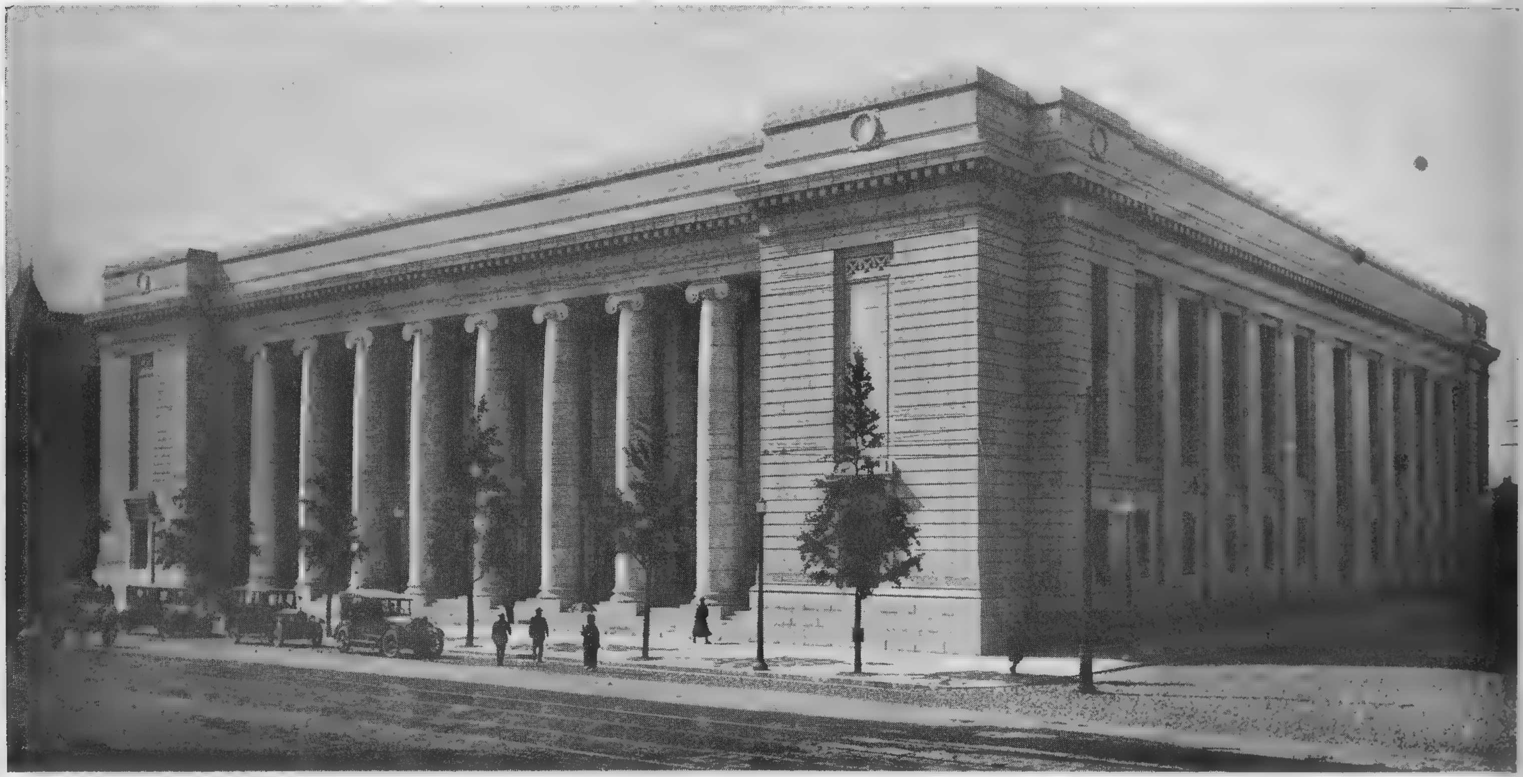
Another View of the Yokohama Specie Bank in Process of Construction



ERECTING THE STEEL WORK FOR THE YOKOHAMA SPECIE BANK

Showing Bank of Japan in Background

Showing Mitsukoshi Building in Background



THE MITSUBISHI BANK

A solid granite edifice that has defied every earthquake shock. One of the most impressive financial structures in the world.
Dr. Kotaro Sakurai, Architect.

The Mitsubishi Bank

IN the center of Marunouchi, the heart of modern Tokyo, the Iwasaki interests have erected a great Bank building which in substantial construction and architectural beauty has set a standard by which all buildings erected in Tokyo will be judged in future. The pure classic architecture of the building makes it in appearance more like a temple of commerce than a banking house. Built of white stone in a city where the smoke nuisance is almost unknown, it attracts every eye that passes.

The building houses the head office of the Mitsubishi Bank, and covers an area of 30,508 square feet. With its basement and four office floors the total floor space is 105,336 square feet. The foundations are concrete laid on wooden piling, sunk fifty feet below the surface.

The building is built of American steel, with an outer facing of white stone known as Inada-Mikage marble. The inner walls are brick or hollow tile, absolutely fireproof, and all floors are reinforced concrete. This flat roof is made of five layers of asphalt and malthoid, over which concrete tiles are laid.

The main banking office is worthy of the finest traditions of banking architecture anywhere in the world. The room is vast and spacious, 140-ft. long and 70-ft. wide, with a ceiling 45-ft. wide. Including the loggia, the room is 176-ft. long and 31-ft. wide. The walls and floors are of marble, and the panelling is mosaic.

Magnificent bronze doors made by the Jackson Company of America are provided for the three entrances to the banking room. In design and finish of workmanship they are equal to the best examples of medieval art, harmonizing with the architecture in absolute perfection. The counter of the banking office is made of Mikage stone highly polished, and the bronze grille which surmounts it is made by the Jackson Company. The waiting-room is finished in especially imported Verona red marble.

The safe deposit vault is one of the finest in the world. It is equipped with 3,578 boxes, large and small, made by the Mosler Safe Company. There are five steel reinforced vaults which house the safes of the bank, two of them on the main floor and three in the basement. The finest vault, the case vault, is equipped with a special Chubb door, having three Chubb time locks.

The main banking office and the vaults are heated and ventilated in the most modern American manner. The office rooms are heated by a low-pressure steam system. The Otis Elevator Company has installed two passenger elevators, one freight elevator, and one dumb-waiter in the building.

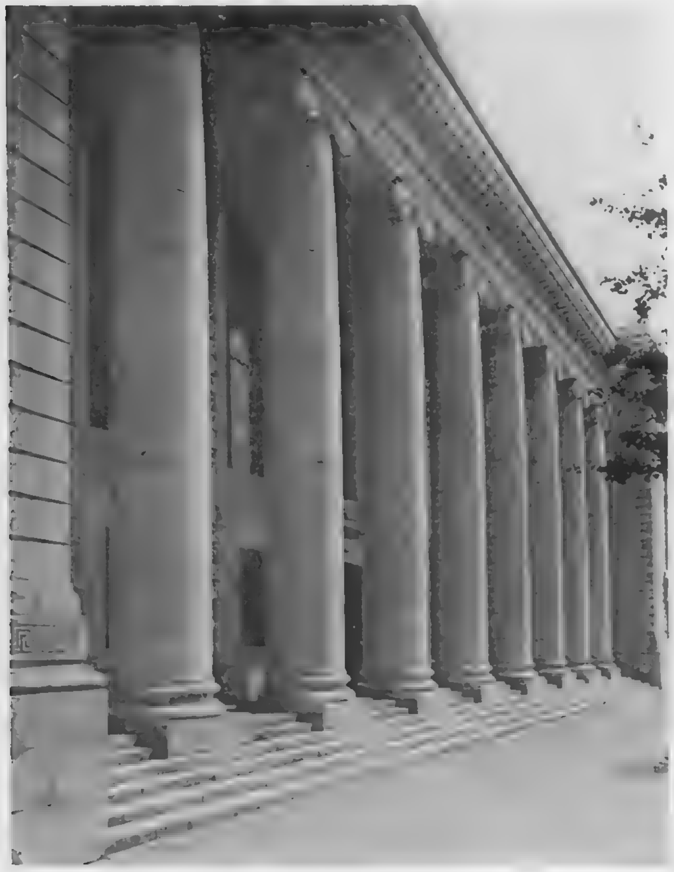
The first and second floors contain the offices of the directors and the directors' room, finished in marble and teak, with floors of mosaic tile.

Throughout the building the lighting is indirect, and the main banking office is lighted through an ornamental stained glass ceiling by which 100 X-ray light reflectors pour their soft light. The brackets and light stands in this room are made of bronze and were all imported from America.

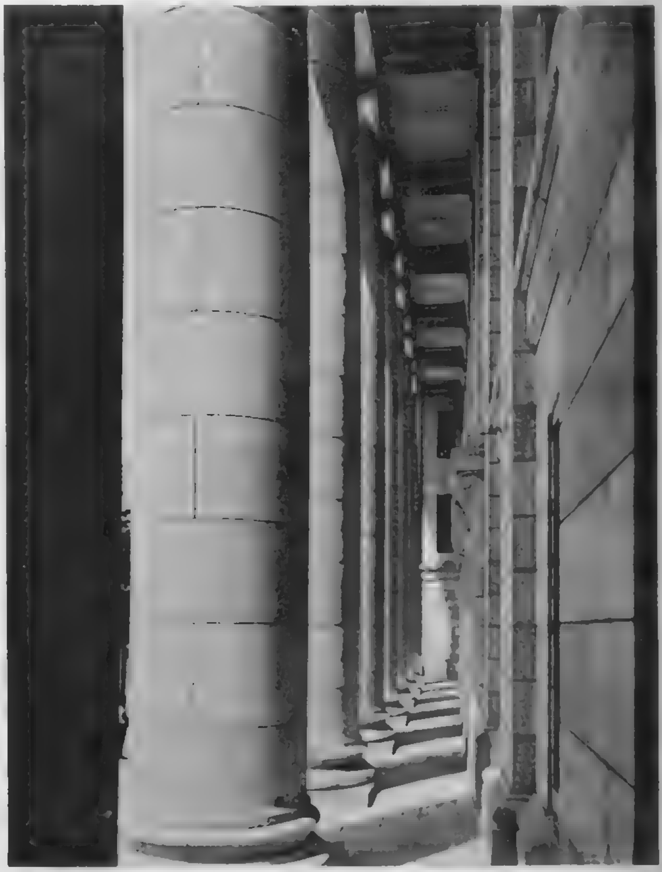
There are seventeen hydrants installed in all parts of the building served by a 7½ h.p. turbine pump installed in the basement. In the same room a 3 h.p. pump supplies all the water for sanitary purposes, and discharges the refuse water into the city sewer system.

This building, which is a credit to its owners and the city of Tokyo, was designed by Dr. Kotaro Sakurai, who is also in charge of the designing of many of the new Government buildings to be erected in Tokyo under the Reconstruction plans.

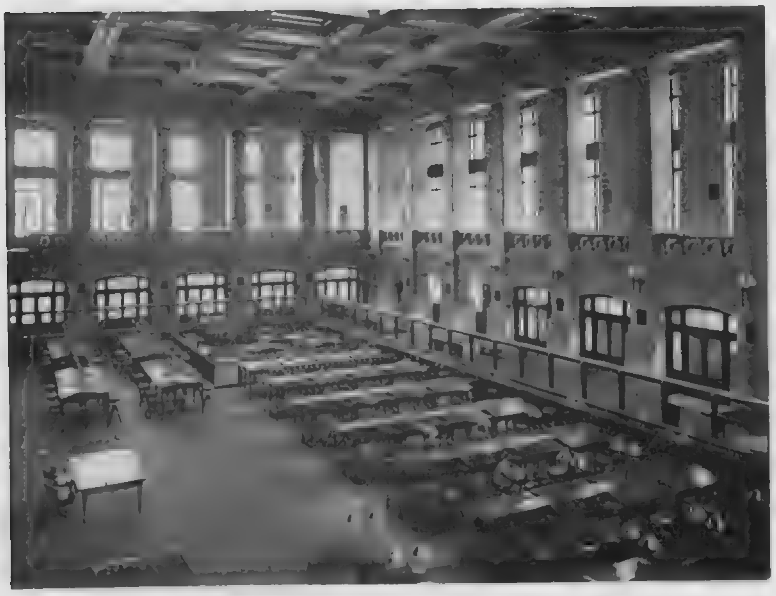
The Main Banking Room of the Mitsubishi Bank, Tokyo



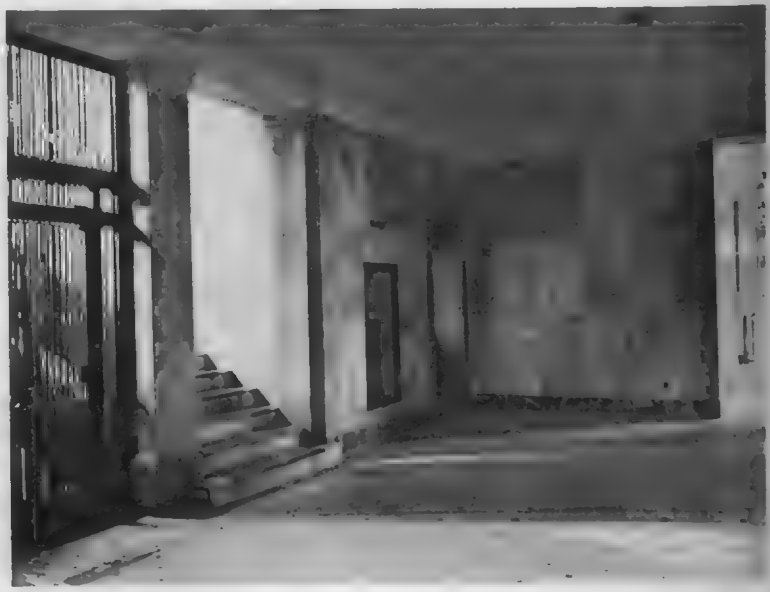
The Mitsubishi Bank Building, Tokyo



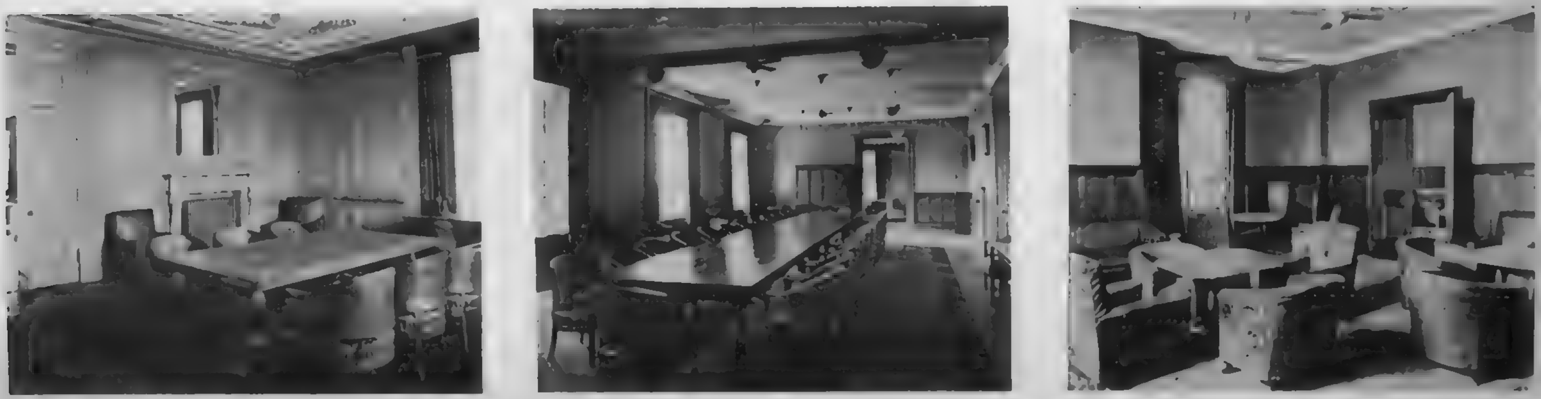
The Colonnade of the Mitsubishi Bank



Interior of Banking Room



Stairway and Hall



Directors and Board Rooms

THE MITSUBISHI BANK BUILDING, TOKYO

Vault Galleries

Interior of Safe Deposit Vaults

MAIN ENTRANCE TO THE MITSUBISHI BANK
The Heavy Bronze Doors made in America cost $45,000

Foreign Borrowings of Japan

By Elgin E. Groseclose, special agent, U.S. Government Finance and Investment Division

THE first large-scale flotation of Japanese bonds in the United States occurred in 1905, when New York shared with London, Paris and Berlin in an issue of £25,000,000 for the consolidation and redemption of the fourth and fifth issues of Exchequer bonds. A previous loan of £10,000,000—the first foreign borrowing of the Japanese Government—had been raised in London in 1899 for the purpose of meeting the expenditures required for the construction of railways, steel manufacturing, and the extension of the telephone system.

During 1905 Japan also raised £60,000,000 in two issues of £30,000,000 each, to meet the extraordinary expenses of the war with Russia—the first jointly in New York and London, and the second in London, New York, and Germany.

Loan for Reconstruction Purposes Floated in United States in 1924.

At various times in 1907, 1910, 1913, and 1920 Japanese loans were placed in London and Paris. In 1924 a $150,000,000 loan was floated in New York for reconstruction purposes following the earthquake. This was the first Japanese governmental loan expressed in dollars. At the same time £25,000,000 were raised in London. Of the $150,000,000 loan an amount of about $25,000,000 was sold abroad, largely in the Netherlands, and approximately $66,000,000 of the loan were used to retire previous issues.

Industrial and Private Issues Offered.

The first Japanese industrial loan publicly offered in the United States was a Government-guaranteed issue in 1923—that of the Oriental Development Corporation—for $19,900,000. In 1924 two issues were floated, one of the Industrial Bank of Japan for $22,000,000 and one of the Great Consolidated Daido Electric Power Co. for $15,000,000; and, recently, a $15,000,000 loan was offered for the Toho Hydro-Electric Corporation. Although the Government has announced its intention of seeking no further loans abroad this year, large sums are being sought by private corporations, particularly hydro-electric enterprises.

Total Debentures of Bank and Corporations Summarized

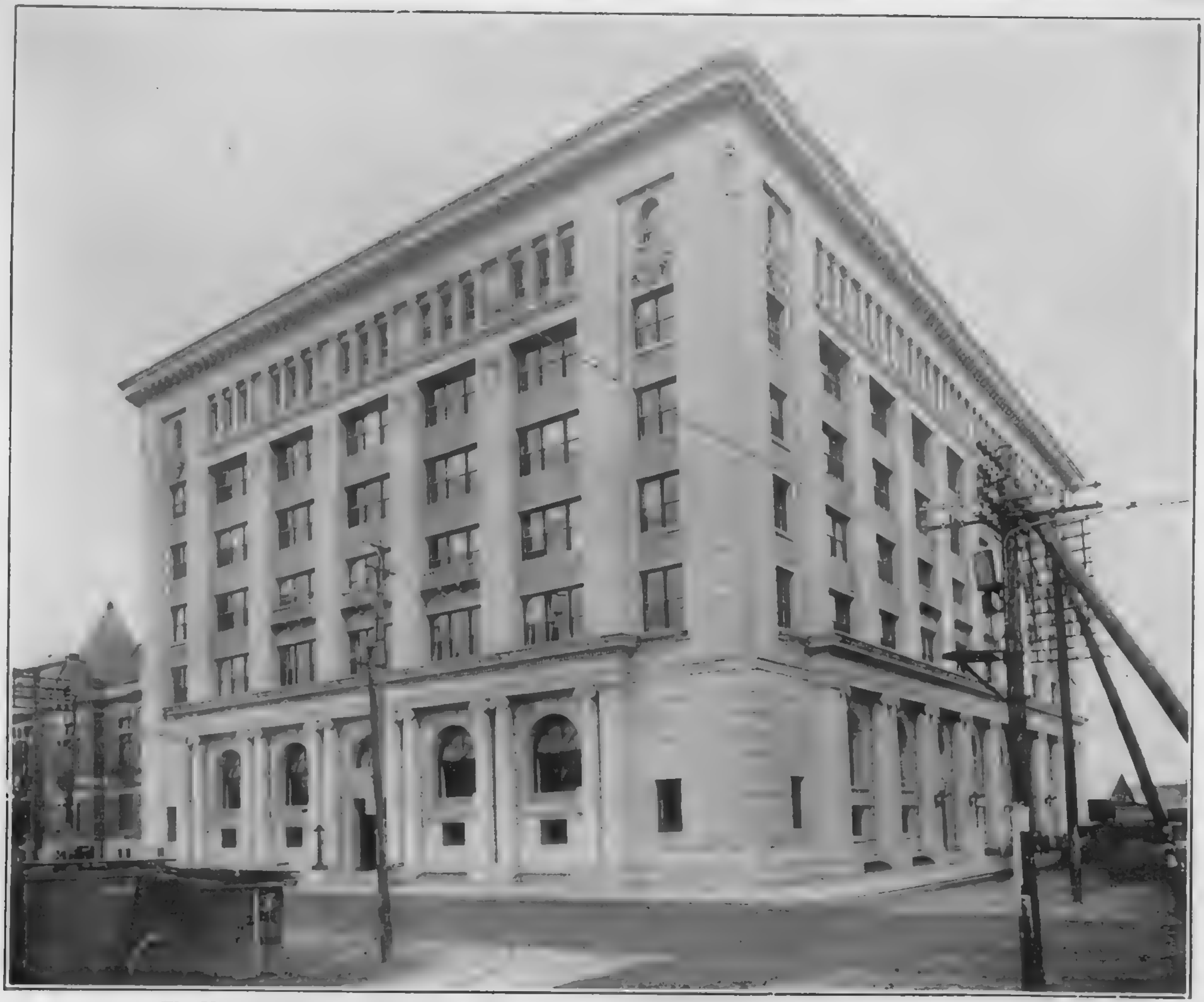
Since the earthquake the amount of loans floated at home and abroad has increased tremendously. According to an investigation made by the Industrial Bank of Japan, the total debentures issued by banks and corporations in 1924 amounted to 931,542,000 yen, compared with 282,661,000 in 1923. The totals for each year since 1912 follow:

	Yen
1912	15,650,000
1913	38,504,000
1914	6,961,000
1915	48,688,000
1916	47,860,000
1917	57,606,000
1918	78,529,000
1919	141,669,000
1920	142,780,000
1921	216,750,000
1922	173,150,000
1923	282,661,000
1924	931,542,000

Foreign Borrowing an Advantage—Need for Capital.

The advantage of foreign borrowing is indicated by the high interest rates prevailing in Japan. The average rate of interest on current deposits throughout the country has risen gradually from 3.2 per cent. in 1912 to 3.6 per cent. in 1921; on savings deposits, from 4.8 per cent. to 5.1 per cent.; on loans, from 9 per cent. to 10.9 per cent.; and on discounted bills, from 8.8 per cent. to 10.7 per cent. Call money during 1924 reached its highest in January, at 9.67 per cent., and the lowest in June, 4.01 per cent.

The situation of Japan financially is similar to that of the western United States in its early days. A vast development is under way, for which the domestic supply of capital is insufficient. This handicap was accentuated by the earthquake and fire of September 1923, and the restoration work consequent will require enormous expenditures for some time to come.



The New Building of the Industrial Bank of Japan: A Reinforced Concrete Structure Erected by the Obayashi Gumi which withstood the Earthquake without the Slightest Damage

The Industrial Bank of Japan

ONE of the most modern-equipped bank buildings in Asia is the handsome new edifice erected by the Industrial Bank of Japan in the heart of Tokyo's financial district, next door to the Bankers' Club. This building was only completed on June 15, 1923, a month and a half before the earthquake, and came through the severe shaking up and fire without a crack or damage of any kind, a high tribute to the quality and excellence of the work of the Obayashi Gumi, its designers and constructors. The building is seven stories and basement, 98-ft. 6-in. high from the ground to the eaves, covering 561 *tsubo*, with 4,171 *tsubo* of floor space.

In preparing the foundations, the site was excavated for 14-ft. 6-in. below the street level, and Douglas fir piles 45-ft. long driven down to make the foundation for concrete. The entire structure is of reinforced concrete, with a curtain wall up to the second story of granite, and above this American *terra cotta*. The inner walls are of hollow fireproof brick, metal lath and mortar. The floor and roof are of concrete, all covered with linoleum except the main banking and customers' rooms, which are laid with mosaic. The roof is covered with three layers of Rubberoid roofing, over which tiles are laid.

The windows and doors are of fire-resisting wired glass, with plate glass in all outside windows. Doors are made of teak or cherry wood, and all hardware is American. The heating apparatus is a low-pressure steam system with boiler in basement. The 1st, 2nd and 3rd floors are equipped with apparatus for supplying warmed or cooled fresh air. To cool the air an artesian well was sunk which can supply about 400,000 gallons daily. There is one tank on the roof which regulates the supply of water at high pressure for fire-fighting apparatus and for sanitary purposes. Water for the kitchen and dining-room also comes from the roof tank. Another storage tank for hot water is also built on the roof.

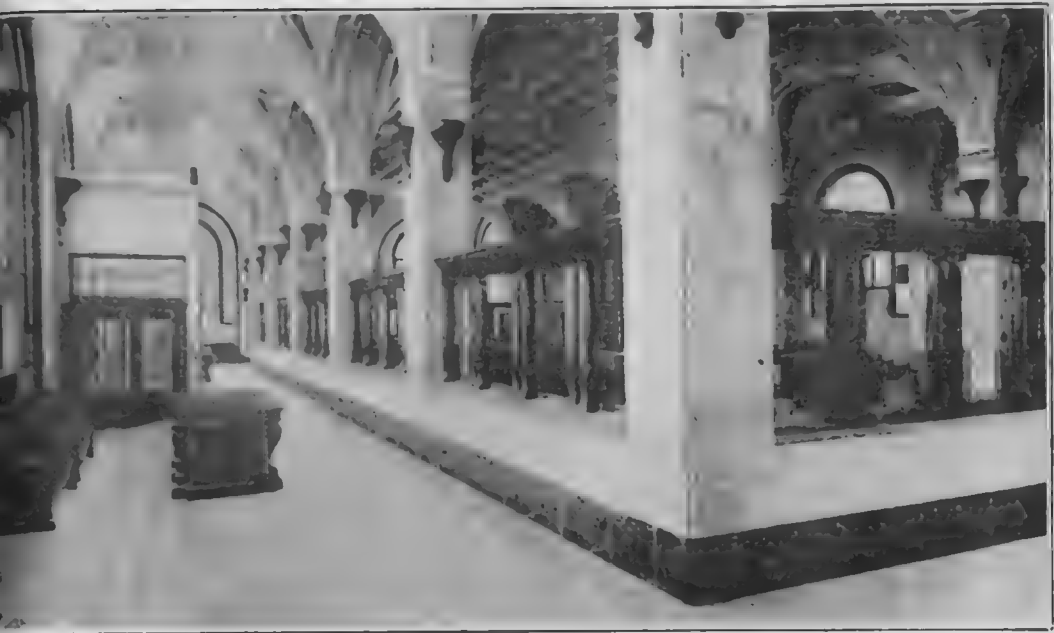
All sewage is discharged into a septic tank in a separate building, where the purified sewage is carried into the city sewers. Each floor has connections for an electric vacuum cleaner, and a pneumatic carrier is installed between the business office and the third floor bureau of accounts. There are five elevators for the public, each 2,000 lbs. capacity, speed 300-ft. a minute, and one lifting 5,000 pounds. There is also one Japanese-built freight elevator and Japanese-made dumb waiters equipped with speaking tubes.

An American mail shute is on all floors. Electric power for the building is supplied by the Tokyo Electric Light Company, the equipment consisting of a step-down transformer, reducing from 330 volts to 210 and 105 volts; 758 lights, equivalent to 8,000 ten c.p. lamps; 500 light switches; and 37 electric motors supplying 229 h.p. power.

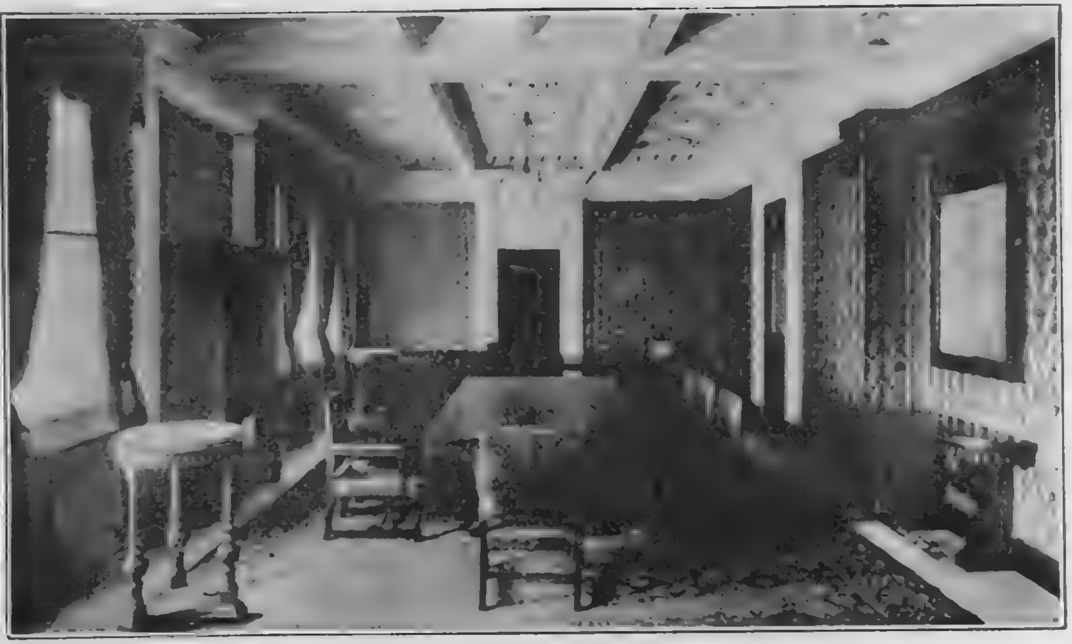
There is also electric heating equipment for emergency and after office hours, and 13 electric hot-water heaters. The Bank office is equipped with cables for 250 telephones, also one master magneto electric clock of Swiss manufacture, and 89 others. The cash safe is 20-ft. wide, 35-ft. long and 9-ft. high, with a door which is 18-in. thick, and the safe deposit vaults are 20-ft. wide, 45-ft. long and 9-ft. high, and have a round door of the latest pattern, 23-in. thick. 1,600 safe deposit boxes are provided. All safes have time locks of the most up-to-date construction.

THE NEW HOME OF THE NIPPON KOGYO GINKO

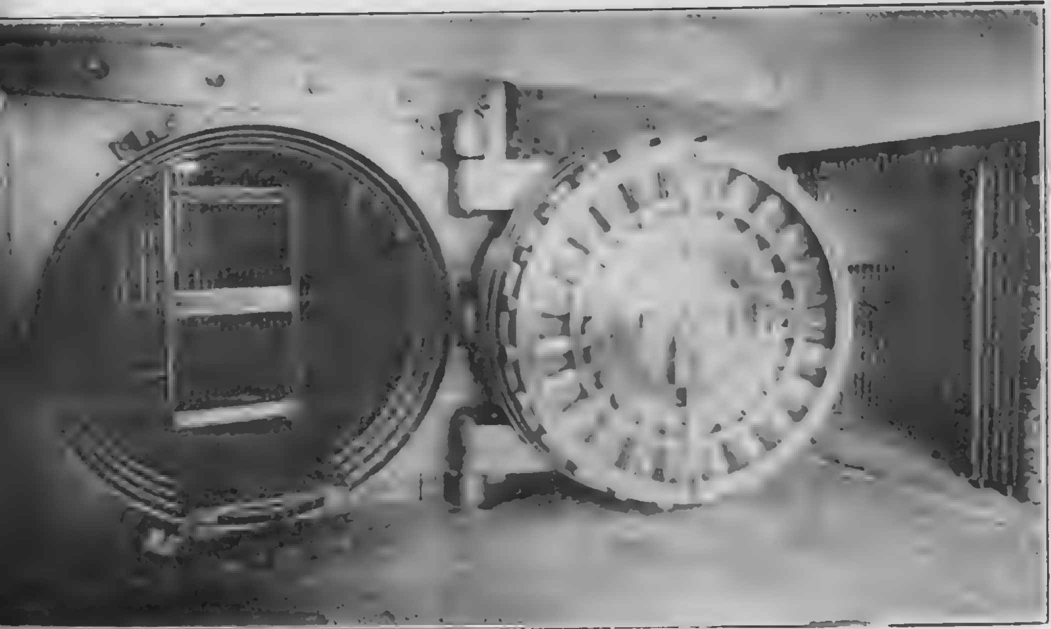
(INDUSTRIAL BANK OF JAPAN)



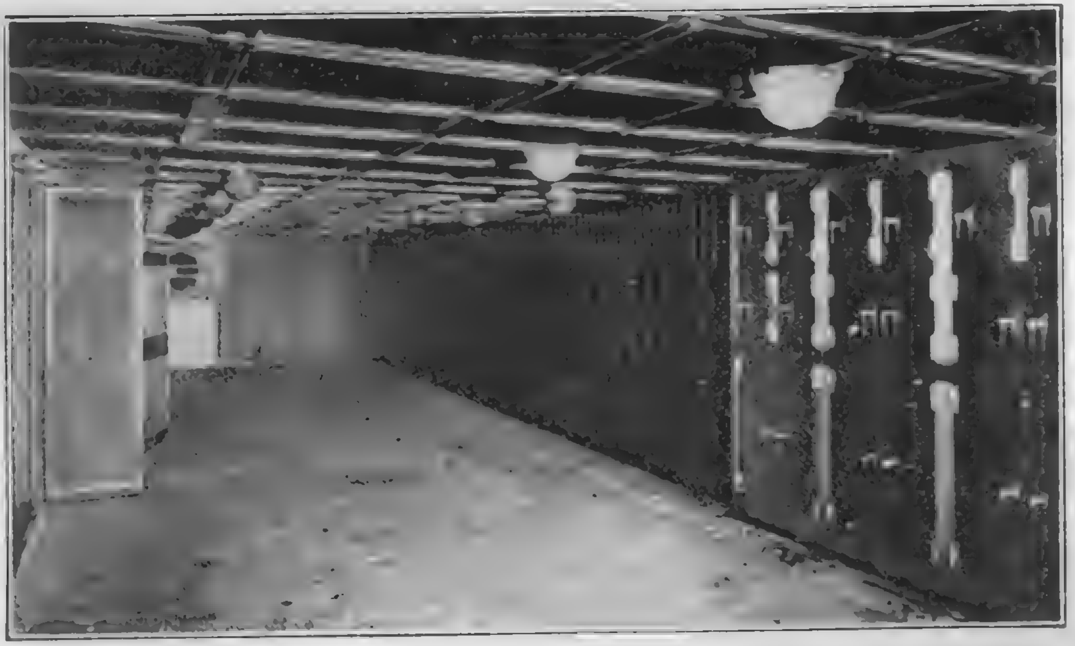
Banking Floor



Board Room



Vault Door



Safe Deposit Boxes

Building Construction for the New Tokyo

By R. F. Moss, Associate Member, American Society of Civil Engineers; Vice President, Truscon Steel Company of Japan, Tokyo

IMMEDIATELY following the great earthquake and fire of September 1st, 1923, it was my privilege to make a detailed examination of a large number of structures in the zone of the great catastrophe, including some structures destroyed by the earthquake, some destroyed by the fire, some that came through both ordeals undamaged, and others in various states of partial destruction from both causes. Since then our company has had a committee continually working on the investigation of building construction suitable for a country of severe earthquakes, and in this work we have accumulated a very large amount of data, but most of this is of a technical nature and not suitable for an article of this kind. Many of the conclusions reached, however, can be stated in non-technical language, and it is the purpose of this article to present a non-technical discussion of the general problem of building construction, both fireproof and not fireproof, suitable for such a country as the part of the Empire of Japan that is subject to destructive earthquakes.

Iwai Office Building, Yokohama.

Reinforced concrete skeleton construction with concrete joist hollow floors and roof, and with metal lath and plasterceilings; continuous reinforced concrete foundations without piles. Reinforced concrete walls and partitions. Contents and all interior wood work destroyed by fire and building settled appreciably, but no structural damage done.

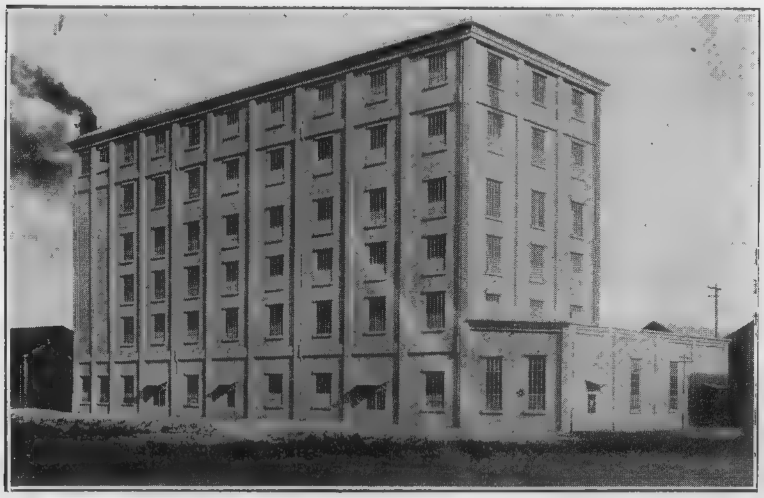
I will take up first the way in which an earthquake does damage to building construction generally, pointing out some of the lessons that follow naturally from an analysis of this kind, and then proceed with the lessons learned from detailed observations of buildings in the earthquake zone.

An earthquake consists of vibrations, both horizontal and vertical, in the earth's crust. These horizontal and vertical vibrations may occur simultaneously, and the horizontal vibration may occur in several directions during the same earthquake. The amplitude, that is the maximum horizontal movement in any direction, may in the case of destructive earthquakes be as much as eighteen inches. It varies considerably for different localities during the same earthquake, and varies in the same locality according to the hardness of the earth's crust at any point, the amplitude, and therefore the severity of the earthquake, being generally greater in soft than in hard soil. Seismologists and engineers rate the severity of earthquakes by acceleration, this meaning of course the rate of increase in the velocity of the earth's surface at the point under observation. In the downtown part of Yokohama the maximum acceleration during the great earthquake was about eleven feet per second, the time between successive shock waves about one and a half seconds, and the maximum amplitude about fifteen inches. This means roughly that a given spot on the earth's surface, quiescent to begin with, attained a velocity of three or four miles per hour, slowed down to quiescence again, moving about fifteen inches in the process, then reversed its direction and repeated the process back to the starting point, all in one and a half seconds. I give the velocity in miles per hour rather than in feet per second because it is easier to understand velocity when expressed in that way.

The vertical movement and acceleration is usually from one-sixth to one-third as much as the horizontal. If we compare the vertical acceleration to the acceleration caused by the force of gravity, we find that the former is seldom, if ever, greater than about one-tenth as much as the latter. The horizontal acceleration may, however, be as great as four-tenths of the acceleration caused by gravity. The really destructive portion of an earthquake seldom lasts longer than about ten seconds.

Now if we consider the probable effect of these movements on a building of any kind, we immediately see that the vertical movement can hardly cause any damage at all. Buildings are necessarily designed to resist vertical forces and are nearly always designed with what we call a "factor of safety" of at least three, by which we mean that each part is proportioned to resist a force at least three times as great as the force of gravity can bring to bear on it. Inasmuch as the vertical part of the earthquake exerts a force of not more than one-tenth the force of gravity, it is clear that this part of the earthquake cannot harm any properly designed building. It is also clear that there can be no appreciable difference in the lifting of different parts of the same building by the vertical vibrations, because the earthquake wave length varies from thirty to three hundred miles. We may therefore, with perfect safety, eliminate the vertical vibrations from further consideration.

Taking up next the horizontal movement we can see that any movement of the earth must necessarily be, at least partly, transmitted to the foundation of the building, which will move in the same direction and with approximately the same acceleration as the earth surrounding it. The inertia of the upper portion of the building tends to make it stay in its original position, and the walls and columns are suddenly called upon for the strength necessary to overcome this inertia and move the building with the foundation. Successive shock waves follow, each moving the foundation horizontally, forward and backward, the walls and columns having to perform the work of moving the part of the building that is above them with each successive horizontal movement of the earth. As the walls and columns of each floor have only to do the work of moving that part of the building which is above them, it follows that the walls and columns of the first floor will be called upon to resist forces greater than those which must be resisted by the walls and columns of the second floor, and that these in turn must resist forces greater than the forces to be resisted by the walls and columns of the third floor, etc.; these forces decreasing from a maximum just above the foundation to nothing at the roof. It also follows that the greater the weight of the floors and roof, the greater will be the work to be done by the walls and columns, and therefore the greater the strength required in these parts of the



Toa Flour Company, Factory Building, Tokyo.

Reinforced concrete skeleton construction with concrete joist hollow floors; reinforced concrete mat foundation supported on wood piles under whole building. Very soft soil. Reinforced concrete walls painted with "Stonetex." No damage of any kind.

structure. If the combined strength of the walls and columns at any level is great enough to move that part of the structure which is above them, they will stand, otherwise they will fail, either wholly or partly.

In a number of buildings in the Marunouchi district of Tokyo the greatest damage was usually found between the second and third floors, and the question naturally arises as to why the greatest damage was not between the first and second floors if that is where the greatest forces are to be resisted. The answer is that the walls of the first floor are usually made of well laid stone and are strong enough to do the work that they are called upon to do, that is, to move the part of the building above them, but the walls of the second and higher floors, made of brick or terra cotta, which are much weaker materials, were in some cases not strong enough to move the part of the building above them. In such cases the maximum damage was usually observed just above the junction of the stronger and the weaker wall material.

Now with regard to floors, my observations lead me to believe that no building earthquake failure was started by a floor failure but that in every case of a damaged building the failure started in a column or wall failure, and this is easy to understand because the floors are in the same plane as the damaging horizontal motion. The tendency is to move them horizontally, but there is very little tendency to distort them. If the vertical motion were sufficiently severe to cause damage, we would expect it to occur in floors, but I have already shown that this is impossible.

From this reasoning it follows that in designing buildings to resist earthquakes, the floors should be made just as light as it is possible to make them without sacrificing other important qualities, such as fireproofness, permanence, rigidity, etc., but that walls and columns *must* be made strong enough to do the work that they will some day be called upon to do, namely, to move the weight of the whole of the construction that is above them, in any horizontal direction and at an acceleration that should be determined by experts for each locality.

If we attempt to ascertain how much of the work of moving the weight of the portion of the building that is above any level is done by the columns and how much is done by the walls, we immediately see that it must nearly all be done by the walls or the walls will fail, especially in the case of steel frame buildings, as the following reasoning demonstrates. Columns, whether of steel, wood, or reinforced concrete, no matter how strong, always have a certain amount of elasticity, and when a (vertical) column is suddenly called upon to resist a violent horizontal movement, it must necessarily deflect more or less, the amount of the deflection depending on the stiffness of the column. Now, no matter how small this deflection is, the work of resisting the shock, that is of moving the upper portion of the building, must necessarily be at once taken up by the masonry walls because the masonry walls are in intimate contact with the steel columns on all sides and are always, necessarily, stiffer than the columns.

Observation supports this reasoning completely. The Yuraku and Yusen Buildings have columns as strong as any I have ever seen, having been designed especially to resist earthquakes, but the walls of these buildings were damaged in the same way and to approximately the same extent as were the walls of the Marunouchi and Kaijo Buildings where the steel columns were very much lighter. Our examinations of many buildings showed conclusively that the extent of the damage depended inversely on the strength of the walls.

The principle—Light floors and strong walls—is by far the most important consideration in the design of buildings to resist earthquakes. The whole question of proper design rests on this principle.

From the reasoning given above it is also clear that the attachment between the floors and the walls must be strong enough to enable the latter to move the former when the earthquake comes. Many buildings failed from the lack of sufficiently strong connections to enable the walls to transmit the earthquake motion to the floors and roof. Brick walls with floors supported on steel or wood beams and with roofs supported on steel or wood trusses, proved to be a very dangerous type of construction, and the reason for this is that it is very difficult to make a strong connection between such different materials. As far as possible the construction should be homogeneous, for example, steel columns with steel beams, reinforced concrete columns with reinforced concrete beams, etc. The connection between the different parts *must* be adequate.

Keeping in mind the above reasoning it also follows naturally that large open floor spaces in multiple story buildings should be avoided whenever possible, and when large floor spaces cannot be avoided, special precautions should be observed in the design of the walls and columns. The reason for this is that when floor spaces are large, it is difficult to provide sufficient wall strength to move them. For the same reason it is dangerous to build multiple story buildings with too much window area in the outside walls. Wall strength is an absolutely necessary and glass will

Yokohama Y. M. C. A. Building.

Reinforced concrete skeleton construction, with concrete joist hollow floors and with metal lath and plaster ceilings; continuous reinforced concrete foundations on wood piles; brick curtain walls plastered and painted with "Stonetex." Contents and all interior wood work destroyed by fire, but no structural damage done.

Mitsubishi No. 27 Building.

Reinforced concrete skeleton construction with concrete joist hollow floors and metal lath and plaster ceilings; continuous reinforced concrete foundations; reinforced concrete walls; metal lath and plaster partitions. No damage of any kind.

not provide it. These principles will have an important effect on the future design of factory buildings. Owners of such buildings will have to arrange their manufacturing processes so as to allow their floor space to be divided into smaller units by strong partitions. In this way only can safety be assured.

The correctness of the principles thus arrived at has been well established by detailed observation on many buildings, and these principles will undoubtedly be followed in the design of future buildings in the earthquake zone.

With regard to foundations, the available evidence indicates that buildings on strong pile foundations received more shock than buildings on the so called mat or floating foundations, but that greater vertical settlement occurs in buildings on the latter type. In the case of buildings on floating foundations there is probably a considerable amount of slipping between the foundation and the earth directly beneath it, which would reduce the amount of horizontal motion in the building. The crushing of side-walks around buildings, noticed in many places, is evidence of this slipping. I understand that this slipping between the earth and the foundation has long been recognized by architects in Japan, and that it is an old practice to put a layer of sand below the foundation to facilitates lipping and thus reduce shock. Inventors have attempted to utilize this principle by putting buildings on ball or roller bearings, but so far no one has evolved a practical design. If it could be worked out it would undoubtedly nullify the effect of the dangerous horizontal vibrations.

There is no question but that a certain amount of this slipping occurs, and this being the case it is clear that all parts of the foundation should be so well connected together that all parts will move as a unit, and that there will be no difference in the displacement of the different parts. In this, also, observation supports theory, and we find that generally buildings on continuous reinforced concrete foundation stood the effects of the earthquake better than buildings erected on isolated pier foundations.

Taking up next the behavior of different kinds of building materials, our observations show that well laid stone of good quality suffered very little. The behavior of brick walls seemed to depend entirely on the workmanship and quality of the brick and mortar. In Yokohama, brick buildings generally collapsed. In Tokyo, where the shock was less severe, brick buildings generally stood, if of first class workmanship. Terra cotta and hollow tile suffered severely. This is to be expected as these materials have very little structural strength. Structural steel buildings generally stood the earthquake shock but suffered severe damage unless built with strong masonry walls and partitions. This type of construction, however, was generally badly damaged or destroyed by the fire unless fireproofed with reinforced concrete. No other fireproofing material was equally effective.

Reinforced concrete buildings seemed to stand the combined earthquake and fire test better than any other type, with the possible exception of steel frame buildings with reinforced concrete walls, floors, and column fireproofing. Of a total of 593 reinforced concrete buildings investigated in the city of Tokyo, 7 collapsed, 13 were damaged so that they had to be pulled down, 42 suffered severe but reparable damage, 69 suffered small damage, and 462 were not damaged at all. In Yokohama, nearly all of the buildings that remained after the earthquake and fire were reinforced concrete. When we consider that reinforced concrete is a comparatively new type of construction, that very little knowledge of proper anti-earthquake designing methods existed prior to the earthquake, and that the usual method of specifying and making concrete mixtures is very defective, this is really a very remarkable record, and it is easy to understand why Tokyo architects are practically unanimous in their choice of reinforced concrete as the best for important structures of all classes.

At this point I went to digress for a moment to take up the method of specifying concrete mixtures.

The usual method is to specify by volume of contents, for example, one part of cement, two parts of sand and four parts of gravel or crushed stone. If measured as packed by the manufacturer, a cubic foot of cement weights about 95 English pounds. If the same cement is emptied into a box and turned over once or twice with a spade, a cubic foot may not weigh over seventy-five pounds. A 1:2:4 mixture with ninety-five pounds per cubic foot of cement will make good concrete, but a 1:2:4 mixture with seventy-five pounds per cubic foot of cement is very much weaker and will produce very defective concrete of not much structural value. When we consider that the practice of measuring cement by loose volume has been the rule rather than the exception in Japan, we marvel that reinforced concrete came through the recent ordeal with the remarkable record that it did. Architects and engineers should always specify cement in concrete by weight, and should see that the cement is measured in this way on the job. This involves the employment of honest, reliable constractors, and it involves a rigid system of inspection by trained inspectors, who cannot be bought, on every construction job. To secure this kind of inspection it will be necessary to employ higher grade men, and to pay higher salaries than has been customary in the past. To do this it may be necessary for architects to increase their scale of fees. If this is found to be the case, the fees should be increased fearlessly, for only by so doing will the true interest of the building owner and the public be served.

I believe that many buildings which otherwise would have stood, were wrecked because poor workmanship or defective material allowed failure to start at some weak column or wall, thus throwing additional strain on the adjacent parts and allowing failure to proceed progressively until the whole came down.

It is obvious that poor workmanship can ruin the work of the best designer, and it follows that good honest workmanship is just as important as correct design. I therefore consider honest, first class workmanship, to be another of the important principles absolutely necessary to secure earthquake resisting structures, and that it is the duty of every architect, contractor, and owner to see that he gets it. It is the duty of the Building Inspection Department of the city to see that buildings are actually constructed in accordance with approved plans. It is useless to set high designing standards and then, through lack of proper inspection, allow contractors to erect buildings in some entirely different way. To make possible the inspection necessary to accomplish this the city may have to enlarge greatly the Building Inspection Department. If necessary this should be done, for in no other way can further disastrous earthquake losses of both life and property be avoided.

For the floor construction of first class buildings reinforced concrete or reinforced concrete on steel beams fireproofed with reinforced concrete are the only two types of construction that stood both the earthquake and fire, and of the two, the straight reinforced concrete design seems preferable because of the tendency of the concrete fireproofing to crack away from the flat, bottom sides of steel beams and thus leave the beams exposed to fire. When this happens the steel beams may become red hot, lose their strength and collapse. Of all types of concrete floor construction, the type made of joists with hollow spaces between them and with a metal lath and plaster ceiling below, seems to best fill the exacting requirements of lightness, strength, rigidity, and fireproofness. It is light, averaging only about sixty pounds per square foot in weight against an average of more than one hundred pounds for solid beam and slab construction, and its depth gives it the necessary strength and rigidity. The plastered ceiling was usually badly damaged where the fire was hot, but in nearly every case it remained in place long enough to protect the concrete construction above it. The air spaces between the joists no doubt contributed largely toward insulating the concrete against the heat of the fire.

The accompanying pictures of the Toa Flour Company Factory Building, Mitsubishi No. 27 Building, Iwai & Company Office Building, and Yokohama Y.M.C.A. Building, all illustrate this type of construction. The first two, in Tokyo, were not damaged at all; the latter two, in Yokohama, were burned out but suffered no structural damage.

For windows, wire glass set in steel sash stood the fire test better than steel shutters. In many cases the steel shutters buckled and allowed the heat to get in. In a few buildings the heat was sufficiently intense to melt glass, and in such localities both steel shutters and wire glass failed. There is another important reason for favoring steel sash with wire glass, and that is that windows are very much more apt to be shut when the fire comes. They must be closed every night and therefore must be kept in working order, whereas shutters are usually considered as emergency equipment and are not used often enough to keep them in proper condition for quick use when the emergency comes.

The roofs of nearly all important buildings were of prepared roofing felt covered with either gravel or flat tiles. Of the two, the roofs covered with tile stood up best, but the gravel covering was also effective when thick enough. Metal roofs should have felt between the metal and any supporting wood work to insulate the wood from heat transmitted through the metal. Ordinary clay tile (kawara) failed utterly, and the rapid spread of the fire and consequent loss of life was largely because a great deal of the tile had been shaken off the roofs by the earthquake, leaving the wood framing exposed. Asbestos cement tile is greatly supperior because it is light, and each tile is attached so that it cannot be shaken off.

The important principles in the design and construction of buildings to resist earthquakes and fires may then be summed up as follows:

Light floors
Strong walls and columns
Adequate connection between parts
No large unsupported floor spaces
Connected foundations
Good workmanship
Steel windows with wire glass
Light roof covering that will not shake off.

The fire hazard may be greatly decreased by the use of metal trim, metal doors and metal furniture in first class buildings.

The foregoing discussion refers principally to first class fireproof buildings. Besides these there must always be a large number of buildings, principally residences, that cannot be made fireproof on account of the expense involved. For these also ways and means of decreasing danger, both from earthquakes and fires, must be devised. We have spent some time on this question and find that, while the danger from fire can never be completely eliminated, it can be greatly decreased, and that such buildings can be designed and constructed so that they will be almost free from earthquake damage.

In the first place the ordinary tile (kawara) roofs should not be allowed at all. As explained above, the tiles are never in place when they are most needed, after a severe earthquake, and at such a time the unprotected roofs form a terrible fire hazard. The great weight of this type of roof also violates the first principle of correct design, that is, light floors and roofs. If each tile could be fastened in place, and the rest of the structure designed strong enough to transmit the earthquake motion to the roof, such roofs would be reasonably safe, but I do not believe that the city can enforce even the provision of the new building code requiring individual fastenings for each tile. Hundreds of inspectors would be required, and the city cannot afford to organize an inspection department sufficiently large to handle such detailed inspection of thousands of small buildings.

Two better methods suggest themselves, namely, asbestos cement shingles, and flat roofs covered with prepared roofing and flat tiles or gravel. Either would be far superior to the ordinary clay tiles (kawara). Of the two the flat roof seems the ideal solution, especially in crowded districts, because the flat roof could be used as a working space or as a roof garden, made attractive with plants and flowers, where the children could play, and where the whole family could enjoy themselves on hot summer evenings. It seems strange that such a practical and obvious solution should not have already been adopted.

In the framing of small buildings great improvement can be made, both from the standpoint of earthquake resistance and economy, by the adoption of the so called balloon type of framing, and particularly by the use of nails instead of the elaborate mortise joints so commonly used in Japan. The balloon type of framing is economical both in lumber and in carpenter work, and this type of construction properly fastened together with nails is stronger and stiffer than the ordinary framing used here. It is fully described in text and handbooks on building construction, so I will not go into details here. The Japanese type of framing was developed when carpenter labour was cheap, but this is no longer the case, and a more economical solution is an economic necessity. I do not believe that balloon type framing requires more than half the labour required for the ordinary type of framing now in use, and I am confident that it will produce a structure much more capable of resisting earthquakes.

For the outside walls of such buildings, better earthquake resistance and much better fire protection can be had by the use of metal lath and cement stucco instead of thin boards now commonly used. This construction, while more expensive, would also be more permanent. The same construction could also be advantageously used for inside walls instead of the bamboo lath and earth plaster walls now used, thus greatly decreasing the fire hazard. This type of wall and partition construction is practically useless for resisting either earthquake or fires.

There is one precaution that should always be taken in building outside walls of this kind, however, especially in a country of frequent rains, and that is that all stucco walls and preferably all concrete walls should be waterproofed. This protects them from cracking due to expansion and contraction caused by alternate wetting and drying, and from the damaging effect of frost on wet walls. There are two ways of doing this, first, by mixing waterproofing material with the concrete or stucco, and second, by applying a paint especially prepared for cement surfaces, after the concrete or stucco has hardened and dried. Of the two methods the second is superior because concrete and particularly stucco frequently develops small surface cracks in drying, and if the paint is applied after the drying process is complete, these cracks are filled up.

It would also be desirable, from the standpoint of reducing the fire hazard, if the under floors of residences, that is, the floor under the floor mats (tatami) and the roof under the prepared roofing, could be built of reinforced metal lath and concrete supported by light steel or wood beams instead of wood boards as usually constructed. This would give a cement floor surface which would be covered with floor mats (tatami) in Japanese-style houses, or over which a wood finish floor could be laid if desired. A house built with wood balloon framing, flat concrete roof covered with prepared roofing, cement plaster and metal lath walls and ceilings and with concrete floors, would be an ideal construction for resisting both earthquakes and fires. While such construction cannot be classed as fire-proof, it is very nearly so, and would burn very slowly, even in a conflagration.

The suggested improvements for non-fireproof residence construction may therefore be summarized as follows:

Balloon framing.
Flat concrete roofs.
Metal lath with waterproofed cement stucco outside walls.
Metal lath with cement plaster inside walls and ceilings.
Reinforced metal lath and concrete floors.

For one-storey factory buildings, where large open spaces are required for manufacturing processes, the obvious solution would seem to be steel frame construction with roofs of steel sheets, either galvanized or made of a non-corrosive steel alloy and painted, and with walls of the same material, or preferably of metal lath and water-proofed cement stucco. This construction is non-combustible but not fireproof. It is fairly safe from exterior fire damage, and will stop the spread of fire, but can be completely destroyed by an inside fire if the contents include a sufficient quantity of inflammable material. The inflammable material in such buildings should therefore be reduced as much as possible, and when it is impossible to keep inflammable contents so low that no serious damage can result from their combustion, the building should be protected by an *earthquake-proof* sprinkler system. Cost considerations usually rule out the possibility of effective cross connection of foundation in such buildings, but all foundations should be connected along each wall line and should be designed so safely that they can never be overloaded. Such buildings may be damaged by a severe earthquake, but if properly designed the damage will be small.

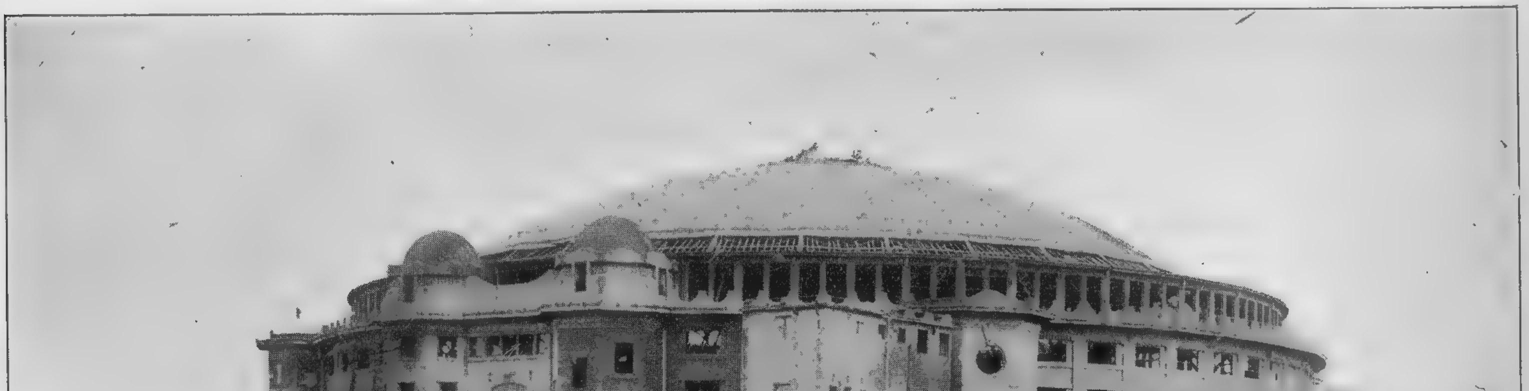
With regard to the question of the maximum height of buildings to be allowed in future, there has been some talk sbout limiting height to two or three stories. I regard this as unreasonable because buildings of all heights up to eight stories successfully withstood the earthquake forces. Many buildings only one and two stories high failed. Height, within the reasonable limit of one hundred feet already established by the Building Code, apparently had nothing to do with it. The proper procedure is: first, to recognize the forces to be resisted; second, to design all structures to resist these forces, and last but not least, to see that the workmanship is of the quality planned and specified by the architect. We should recognize walls as being an integral part of the structure, not simply an ornamental dress to be hung on after the structural part is finished, and make our designs accordingly. We should aim to make our structure as nearly monolithic as possible, remembering that where different kinds of material join we usually have a place of weakness and therefore of danger. Witness facing tiles dislodged from walls all over the city, bricks separated from steel framing, etc., and compare these to the behavior of such monolithic structures as the Mitsubishi No. 27 Building, the Toa Flour Company Building, the Iwai Office Building, and many others. If we follow this procedure I see no reason why we should not continue to erect buildings to the present limit of one hundred feet in height.

In the immediate future, in the study of methods of design and in the drafting of revised building codes, attention is very apt to be concentrated on earthquake resisting qualities to the exclusion of other equally, if not more, important features, such as fireproofness, permanence, and cost. Destructive earthquakes are rare visitors, but fire, rust, decay, and the necessity of making every commercial structure pay for itself, are things that are always with us and they should by no means be forgotten. If all owners could afford to build structures like the Mitsubishi Bank, the problem would be easy, but this is, unfortunately, not the case. With billions of yen in property values destroyed, the necessity for economy will be more pressing in future than in past, and will demand strict attention in every design.

Fortunately, the lessons of the earthquake do not rule out the economically designed structure but are rather to the contrary. They tell us, for instance, to avoid all unnecessary ornamentation because it is dangerous when it breaks off and falls down, and also because it loads the structure with additional weight which the walls and columns must move. They tell us to avoid all attempts at massive effects, but to make out structures light and strong which will also make for economy.

I do not believe that architects will continue to design large steel frame structures in Tokyo. They resist earthquakes very well when the walls are properly designed and built as an integral part of the structure, but many steel frame buildings which came through the earthquake intact were so damaged by the fire that they had to come down. Unless such structures are properly fireproofed with concrete, an no other system of fireproofing stood both the earthquake and the fire, they will very probably fail. If fireproofed with concrete, they are uneconomical when compared with the straight reinforced concrete design. The field for structural steel in Japan will be limited to buildings which do not require fireproofing and this field will necessarily be comparatively narrow.

As I said in the beginning of this article, our company has had a committee working on the problems that I have discussed, and in this work we have collected a large amount of data. We want to make these investigations and this data serve a useful purpose, not only to ourselves but to the public generally, and to this end we offer the use of this information freely. We would expect to derive not only pleasure but mutual benefit from a discussion of these problems with anyone interested in them.



A Triumph for Steel and Concrete: The Famous Ryogoku Wrestling Hall in Honjo. Interior woodwork destroyed by the fire, but no structural damage done

Rough sketch showing types of new reinforced concrete business and residence buildings to be erected along the main thoroughfares of Tokyo acting as fire prevention walls against the spread of conflagrations

Helping the Small Property Owners to Rebuild

The Imperial and Tokyo City Governments Will Advance Yen 60,000,000 to the Reconstruction Building Company, Ltd. for Assisting Straitened Property Owners to Erect Fire-proof Structures

THE greatest sufferers from the quake and fire in the devastated districts were the small property-owners whose houses and shops were completely destroyed and on which they failed to collect insurance. The insurance companies, whose main assets also disappeared in the general conflagration, being unable to meet their obligations to the policy-holders, left the latter to face the problem of rebuilding with the inadequate ten per cent. on the total value of the policy finally paid by some of the insurance companies, or with a further call on their own private resources. When the Government authorities issued the rebuilding regulations providing that all edifices in certain districts and along both sides of the main thoroughfares must be of modern fire-proof construction, it increased the difficulties of these distressed owners in obtaining the capital necessary to comply with the new law.

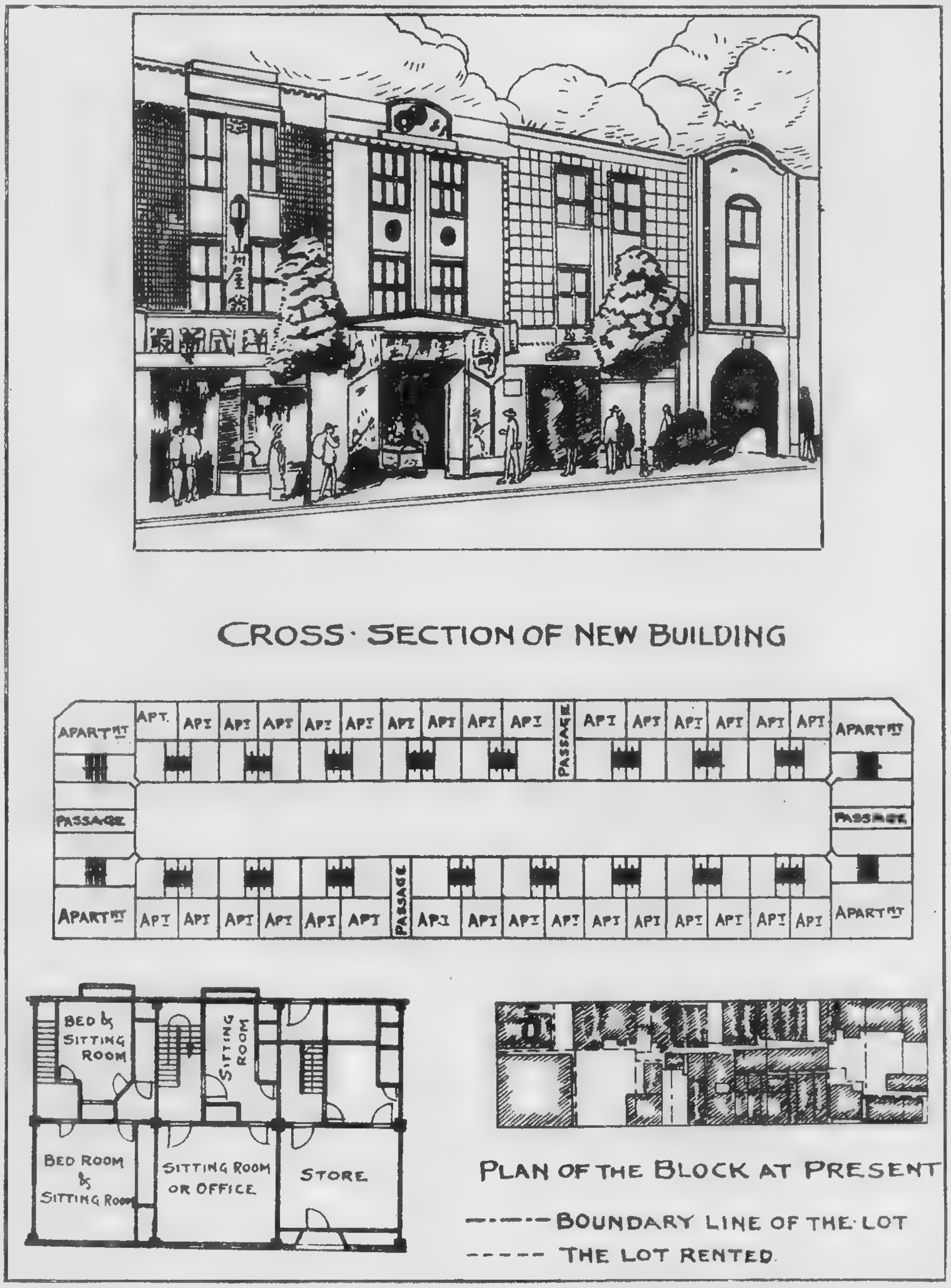
The ashes of the burnt districts had hardly time to cool when multitudes of these small holders were erecting temporary shelters on the site of their old homes, and as the days passed the first rough shacks were superseded by fairly comfortable and presentable quarters. The majority of these structures, however, remain as temporary makeshifts, to be pulled down at the proper time to make way for permanent fire-proof buildings as provided for in the reconstruction program. For the great majority of this class the expenditure for temporary construction has been a severe strain on their slender resources, and unless substantial aid is tendered by the Government the erection of permanent fire-proof buildings will be indefinitely postponed.

The reconstruction authorities have laid down definite regulations for the erection of fire-proof buildings not only in the central financial and business district, but along the main arteries of traffic extending out into the suburbs. The latter are designed to serve as fire-shields and confine a conflagration within certain limits. The city of Tokyo has been destroyed and rebuilt many times in its history as the result of these general conflagrations, and as long as the erection of the old style of flimsy wooden buildings is permitted by the authorities it is only a question of time when another fire will get beyond control and reduce the city to ashes. Extreme measures were therefore imperative to mitigate as far as possible the spread of these fires, and as a partial remedy the city is to be divided into fire zones protected by a wall of concrete or other fire-resisting material built into the houses forming the boundaries of these districts.

The original fire zoning regulations were promulgated one year before the earthquake (September, 1922), and covered only 687,000 *tsubo* of the city's area. Taking advantage of the opportunity caused by the disaster of the following year, this area was extended to 1,519,000 *tsubo*, of which 1,158,000 *tsubo* had been devastated by the fire. Excluding public and other buildings covering 164,000 *tsubo*, which withstood the fire and quake, there remained some 636,000 *tsubo* of which at least 70 per cent. will be utilized for building sites. This leaves about 442,500 *tsubo* on which buildings may be erected. Estimating three stories to each building this makes a total of 1,335,600 *tsubo* of floor space to be erected.

Outside of this fire-proof area an additional 3,964,400 *tsubo* of floor space was destroyed in the fire, of which, at least ten per cent. (396,400) will be rebuilt with fire-proof material, making a total of 1,732,000 *tsubo* of floor space for Tokyo that must be rebuilt in fire-proof materials. In Yokohama, fire-proof construction will be about 20 per cent. of that in Tokyo, or some 346,000 *tsubo*, a total for both cities of 2,078,400 *tsubo*. The estimated cost of construction of each building is about Y.350, per *tsubo* of site, calling for the sum of Y. 242,480,000 to carry out the fire-proof construction program.

As it was manifestly impossible for the impoverished small property owners to find the money on reasonable terms for reconstructing their buildings in accordance with the regulations laid down by the reconstruction board, their situation made a profound appeal to the sympathies of the financiers and authorities. The best solution seemed to lay in the organization of a building and loan company somewhat along the lines of those operating in the United States, and a plan was developed by Viscount Shibusawa, Mr. Jonnussuke Inouye and Mayor Nakamura, in which the national government would carry the initial burden of finding the finances for carrying the scheme into effect through the medium of a private company responsible to the city authorities. Largely through the instrumentality and influence of these leaders of Japan's financial interests, working in close accord and harmony with the Mayor, the plan received the sanction of the municipal assembly and the imperial government.



Sketch showing further types of reinforced concrete business and residence edifies designed by the Reconstruction Board to act as fire prevention walls along main business streets. This also shows the general floor plan and block arrangement of the new building system compared with the old style block of wooden houses

The proposed Reconstruction Building Company is to be organized with a capital of Y. 20,000,000 and conceded special powers to issue bonds to the extent of Y.100,000,000. Of this amount, the imperial government will subscribe for Y.60,000,000 through the Municipality of Tokyo on the condition that Y.50,000,000 be allotted for the rebuilding of the capital and Y.10,000,000 for Yokohama. In addition to this direct financial assistance from the government, the company is empowered to raise a further Y.40,000,000 on its own initiative and security. During the first five years it is estimated that at least Y.20,000,000 loaned to private individuals for the erection of buildings will be repaid with interest, increasing the capital resources of the company to Y.140,000,000 half of this amount (Y.70,000,000) is to be invested in new construction to be repaid in installments extending over a period of twenty years, or, according to the special terms of the individual loan contract. The other half will be loaned to responsible parties for erecting their own buildings. When consruction is undertaken by the company on behalf of the property owner, the latter will pay one-tenth of the estimated cost in advance and the balance in regular installments for the duration of the loan. The limit of loans to those who elect to construct their own buildings is 70 per cent. of the value of the property.

Although entrusted to private management, the company is to be a semi-official enterprise closely identified with the national and municipal governments through a contract under the terms of which the national treasury issues the loan to the public and lends the proceeds to the municipality, which, under the terms of another contract, engages to lend the funds to the company under the following general conditions :

The City of Tokyo will lend to the company the sum of Y.50,000,000 to be obtained from the proceeds of various imperial government issues to be known as Reconstruction Savings Bonds. The first installment of these loans will be issued sometime in the fiscal year 1924-25 and thereafter on such suitable occasions as may be determined by the mayor of the city of Tokyo. The actual amounts raised by the national government and handed over to the municipality must be paid into the treasury of the Reconstruction Company, the municipality paying the national government the same rate of interest as carried on the face of the bonds and charging the same rate of interest to the company. (The interest rate is not specified in the contract as this obviously will be determined at the time the various installments are placed on the market). Repayments are to be made by the company through the municipality at the due dates on which the national government is called upon to redeem its obligations, the Mayor being empowered in every instance to set the date for the company to repay these outstanding installments.

According to the terms of the contract, the activities of the company are confined (1) to the construction of buildings in the burnt districts for the account of property owners, who are to repay the costs in twenty years and (2) to make loans to responsible individuals who desire to undertake construction of fire-proof structures on their own account, said structures to conform to the regulations. Such loans are also to be repaid in twenty years. The amount of the loan for the purposes of construction under the first heading is to be determined by the actual cash outlay, embracing the costs of plans, building materials, contractors charges, inspection and other legitimate building expenses. To this is to be added the lease of land, insurance during construction, with interest on same until the building is handed over. The subsidy granted by the government for fire-proof buildings (if any) is to be deducted from the actual expenses.

In the case of individuals who prefer to do their own construction with loans advanced by the company, they must provide firm and negotiable security. Loans, however, will be made against the actual value of buildings according to work completed. In all cases where the company advances the funds for construction under the first clause, the rights of ownership are vested in the company until all installments are paid, however, if suitable liquid security is offered before the expiry of the loan, the building will be turned over to the new owner. Fire insurance in companies approved by the mayor must be carried on all buildings owned by the company and on which it has advanced loans and should he deem it necessary, he may demand that the city be placed in immediate possession of all rights of ownership of all buildings constructed under the provisions of clause one.

In the case of non-payment of the loans on buildings coming under the head of clause 2, the company will immediately transfer its security to the municipal authorities. Further, the mayor is empowered at any time to call upon the company to transfer to the city all the securities on outstanding loans, and should he decide that these are insufficient, the company must make good the deficiency. The company must also make full monthly reports to the mayor, accompanied with statements and vouchers.

The contract also provides that when the profits of the company are under ten per cent. dividends will be limited to 8 per cent. the balance being placed to a reserve fund for equalization of dividends. When the profits exceed 10 per cent. dividends of ten per cent. may be declared and any surplus shall be paid half to the shareholders and the balance placed to reserve for the repayment of capital advanced by the city.

The Municipality reserves the right immediately to cancel the contract and demand immediate repayment of all sums lent to the company in the event that the terms of the contract are violated, and should the city sustain damages arising out of the violation of the contract, the company is to be held directly liable for indemnity. As long as the company lives up to the letter and spirit of the contract the latter will remain in force even after the capital to be advanced under its terms and all interest charges are repaid. The contract is to be registered and its provisions made public. The repayment of the sums advanced being part of the contract, should the company at any time default on its payments, the city will take compulsory measures to protect its interests. On the other hand, should the company urgently require capital to carry out its program, the municipality may extend the time for the repayment of any installment. Other methods of financial assistance to the company may be considered by the municipality, such as guaranteeing its loans or in other ways, when such assistance is warranted. If payments are postponed, the interest charges and date of redemption will be determined in each case by special agreement. The contract is to become effective when it is approved by the Municipal Assembly and a general meeting of the shareholedrs of the company. However, should the national government decline to carry out its part of the obligation, the contract will become null and void.

The contract places the general supervision of the scheme under the mayor of Tokyo, giving him absolute powers to act in any matter affecting the stability of the enterprise. The actual direction of the company is to be entrusted to some highly placed business executive whose name will be a guarantee to the government and people that its operations will be carried out on a non-political basis and in strict compliance with the terms of its contract with the city.

Baron K. Nakajima (president of the Furukawa Electric Company), has been prevailed upon by those responsible for the organization of the company to accept the presidency.

Restoration of a Factory Plant in Japan

T. Tsumori, Tokyo Electric Co., Ltd.

THE earthquake of 1923 wrought havoc with our factory buildings at Kawasaki, and for the time deprived Japan of one of its most important sources of incandescent lamps.

Temporary measures were immediately undertaken for restoring production of this important staple, and within six weeks after the disaster we were turning out lamps in even greater volume than our normal rate of production.

In the year 1924 the time had passed for temporary readjustments, and the age of restoration came. We devoted ourselves to permanent reconstruction, with the result that by the end of the year our factory buildings were completely restored.

The first large one to be completed was a warehouse of reinforced concrete, three stories high, covering an area of 542 *tsubo* (19,512 sq. ft.). The next to be completed was a machine shop of reinforced concrete, two stories high, area 200 *tsubo* (7,200 sq. ft.). The third building of this type, which contained the lamp factory, offices and storage, is a three-storey reinforced concrete building of 432 *tsubo* (15,552 sq. ft.).

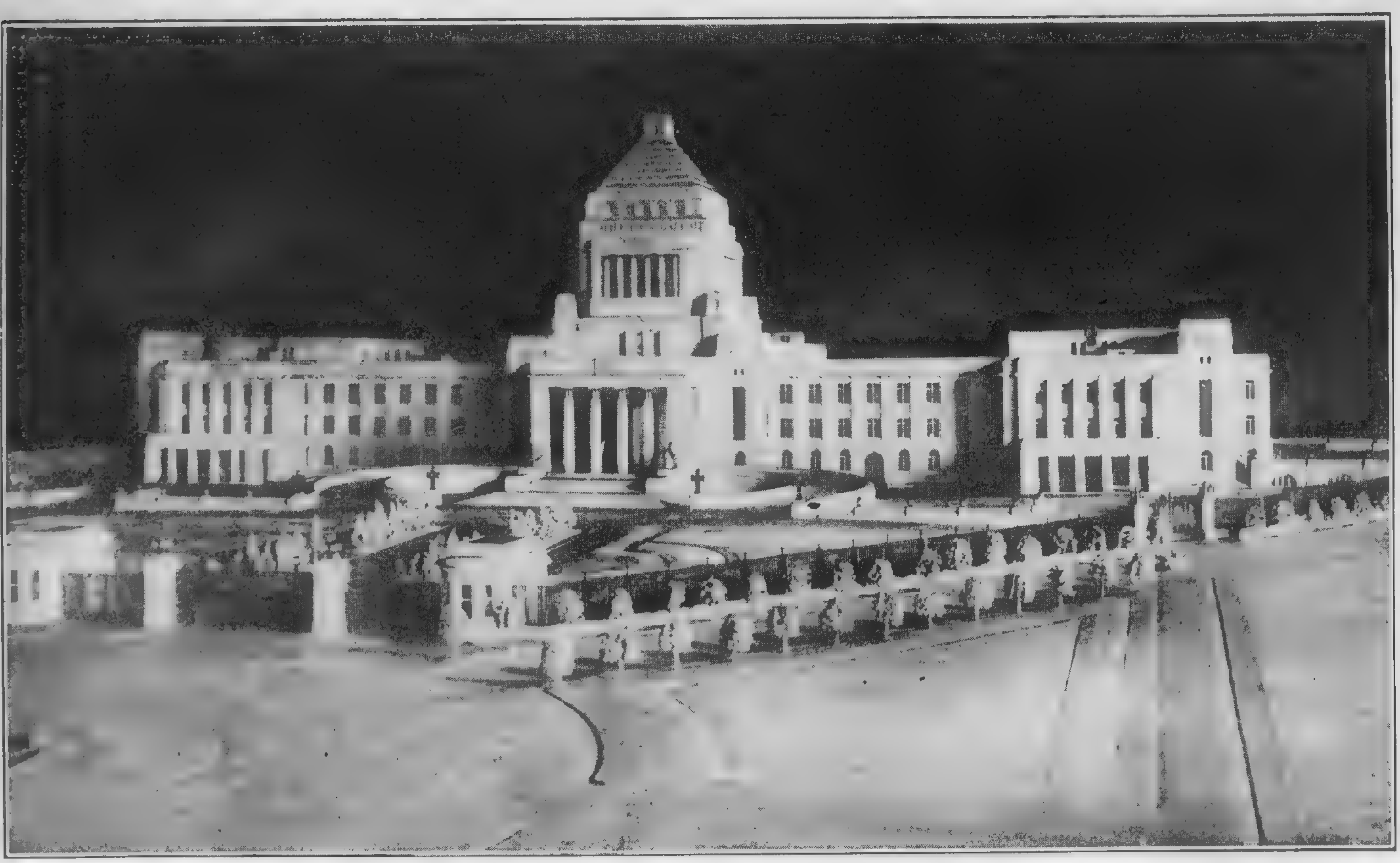
One of the New Buildings

Further, as a supplement to the collapsed buildings, several new wooden buildings were built, including a warehouse of 286 *tsubo*, a laboratory of 178 *tsubo*, and machine shops of 480 *tsubo*. The first of these was completed in February, and the other during May 1924.

Regarding the manufacture of lamps and other products, admirable concentration of energy was made both by officials and employees, resulting in the quick restoration of the manufacturing capacity. Under the disordered conditions immediately after the catastrophe they made special efforts for this purpose, with a strong sense of responsibility for the providing of light in Japan. These special endeavors, combined with the valuable help so kindly given, directly and indirectly, by the General Electric Company, enabled us to see a splendid success in finishing the necessary repairs of the up-ground and underground equipments and preparations for the production so quickly that we could recommence the manufacture of lamps from the 2nd October, say only 31 days after the quake.

On the part of various lighting companies, their restorations were also speendid, which fact, together with the progress of the restoration of the damaged cities and towns, caused a great increase in the demand for lamps. But as our production capacity was very well restored, we could fill all these demands and could well promote the reputation of the "Mazda."

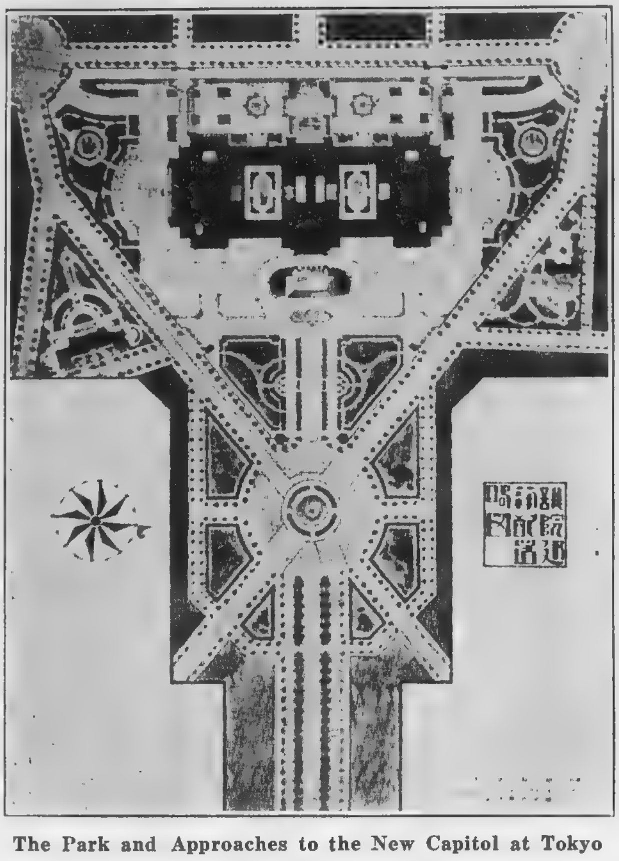
In our Research Laboratory all restorations were completed, and even a remarkable improvement and development were made in the equipments for the research and production of radio apparatus, radio receiving and sending vacuum bulbs, and we are now well prepared both in respect to production capacity and unique skill to meet the growing demand.



The Capitol of the Rising Sun: The New Diet Building at Tokyo

Architecture and the Buildings of New Tokyo

THE new Tokyo will be a replica of any one of a dozen western cities. The simple, refined and beautiful architecture so representative of the spirit of Japan will give way before the more utilitarian ideas of Western efficiency, combined with such structural modifications imposed by the lessons of repeated earthquakes and fires. If Tokyo is to remain the capital of Japan, the flimsy wooden houses must be superseded by fireproof structures of brick, stone, steel and concrete. Tokyo will endure, and it is only necessary to make a hasty trip through the stricken city in order to visualize what it will look like in the future, a typical Western metropolis, with business blocks, office buildings, Government offices, department stores, banks, small shops and standardized apartment houses of steel and reinforced concrete differing little in outward appearance to similar structures in any American city. On all sides such edifices are now rearing their roof lines, indicating in the most positive manner the style of buildings that will eventually fill in the gaps to make a finished city.



The Park and Approaches to the New Capitol at Tokyo

It seems a great pity that the artistically beautiful lines of Japanese architecture are so difficult to incorporate in twentieth century building design; yet, on the other hand, it is a relief to know that the new city will be an improvement on past attempts superficially to imitate foreign styles in houses. In building design and construction practice, as in many other things, the Japanese have learned their lesson by sad experience. Their architects have passed through the purely imitative stage which filled the cities of Japan with reproductions of all that was hideous in foreign building design and successfully mastered western architectural principles and the art of building to the point where many of their latest efforts stand on a par with the highest and best examples of modern American or European practice.

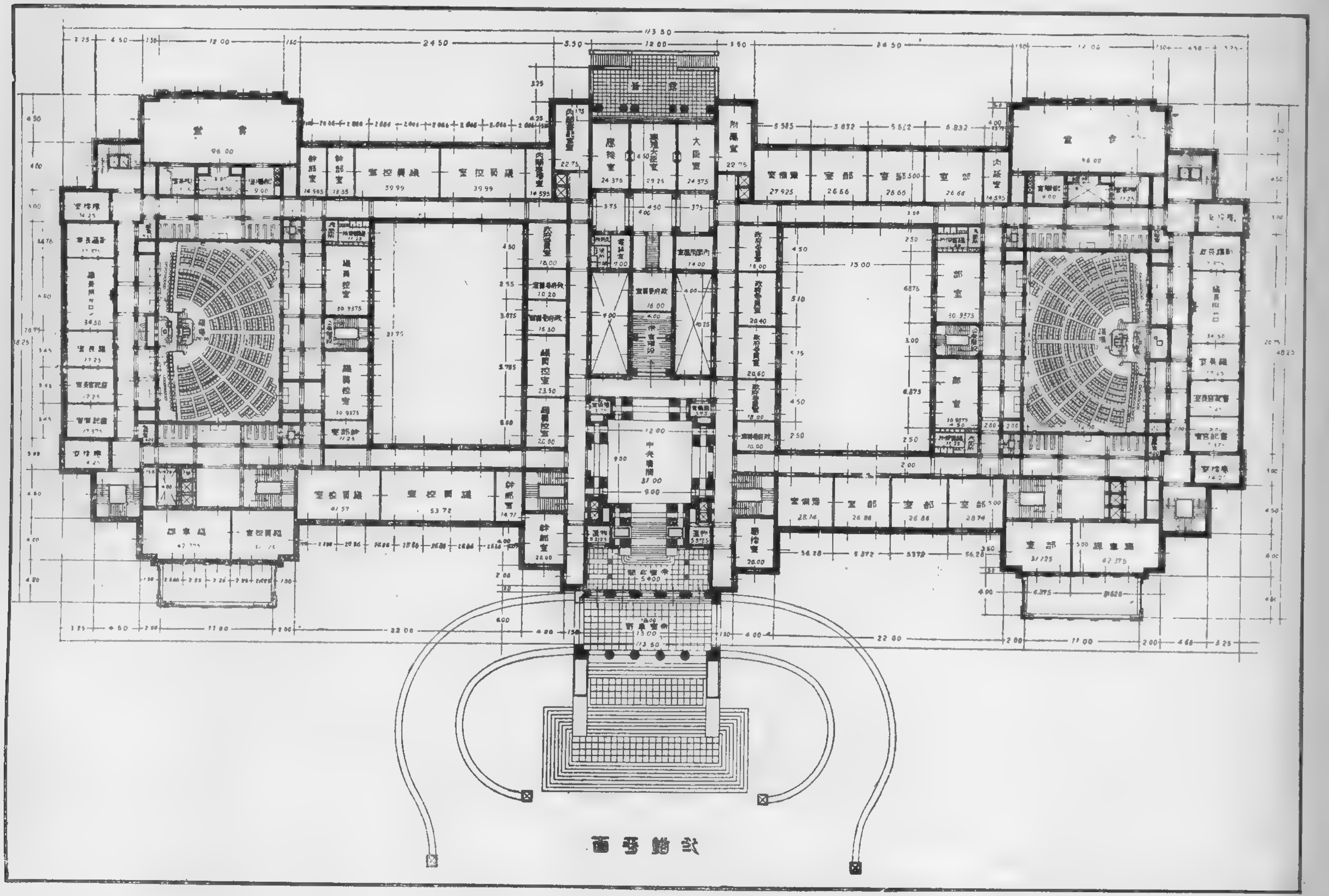
With greater contact with the world there has come a revolt against the shocking so-called European architecture which defiled the land. Due to the necessity of adopting methods at once economical and proof against earthquake shocks, this sentiment unfortunately has not found expression in a revival of the exquisite architecture evolved by the Japanese from the Sino-Korean *motif.* Only at a considerable extra cost can the beautiful lines of their own buildings be reproduced in stone and concrete, so the Japanese are compelled through sheer necessity to adopt designs free from ornamentation, over-hanging eaves, cornices and gingerbread work.

As a matter of fact, it would be difficult to adopt the ancient style of Japanese architecture to modern needs. After all, it is a type of architecture closely related with Buddhist rites and ceremonies, completely out of place when applied to other than temple or purely domestic purposes. The modern architect therefore has been compelled to adopt in their entirety the models and types of business buildings as developed in other countries. Japanese architecture is the apotheosis of wood as building material, and the demands of the present day call for something more durable and safe. These and other reasons have compelled the abandonment of the old style of architecture for modern buildings erected to Western designs.

In the home or family life of the people the architectural changes have been less complete than in the official and business buildings. Many foreign-style residences have been erected, but for the most part these have been additions to dwellings built in the Japanese style. While the former have been used principally for social functions and entertainment, the latter have been devoted to private family life. Different attempts have been made to combine the advantages of the two styles in one structure. There exist some European-style residential buildings which, in addition to rooms fitted up and furnished as in the West, contain chambers constructed in Japanese fashion, with matted floors, sliding divisions, alcoves, and all the features of dwellings of the old style. The contrary method of erecting a residence having all the external characteristics of the old Japanese style and fitting up a part of the interior with rooms in European style with solid walls, fireplaces, folding doors, and parquet floors, is also being followed.

This type of dwelling is becoming more and more standardized, especially since the earthquake and fire, when a large number of American "knock-down" houses and bungalows were imported in order to provide economical and quick shelter. Some of these bungalows were very elaborate and are setting the style in the new suburban residential districts. The experience of the Japanese in Korea and Manchuria, where they have applied the best exterior design of foreign houses and adapted the interiors to their own ideas of comfort, is having its effect upon new dwelling-houses for the home country. In Manchuria, especially in Dairen and Fushun, the new residential sections are outwardly a replica of the Southern California type of bungalow, but designed for severe cold weather. The tendency towards this type of residence is seen in many of the new suburban districts of Tokyo, where real estate companies are adopting the American methods of improving a section of land with streets, sewers, water, light, etc., and erecting thereon standardized bungalow residences for sale or to rent. The boom in suburban real estate has resulted in the erection of more than 150,000 houses since the earthquake and fire. The purchase of land and the erection of tenement houses were undertaken by these real estate companies on a large scale, but the attempt to hold these properties at high prices has since resulted in a decided slump, with consequent financial loss to the promoters.

The introduction of foreign-style buildings of solid construction in Tokyo and some of the principal cities dates back several decades. Among the earliest buildings of this kind were the College of Engineering at Toranomon, the Government Printing Office destroyed by the fire, the Russian and British Legation buildings, the old Shinagawa railway station, two foreign-style palaces for the Imperial Princes, the Military Staff Office, the Foreign Office building, and the National Museum at Uyeno. Following these were erected the first blocks of the Tokyo University buildings at Hongo known as the Law and Literature Department. Other blocks have since been carried out in varied styles of architecture, rather to the loss of unity in design. At a later date the fine Government buildings

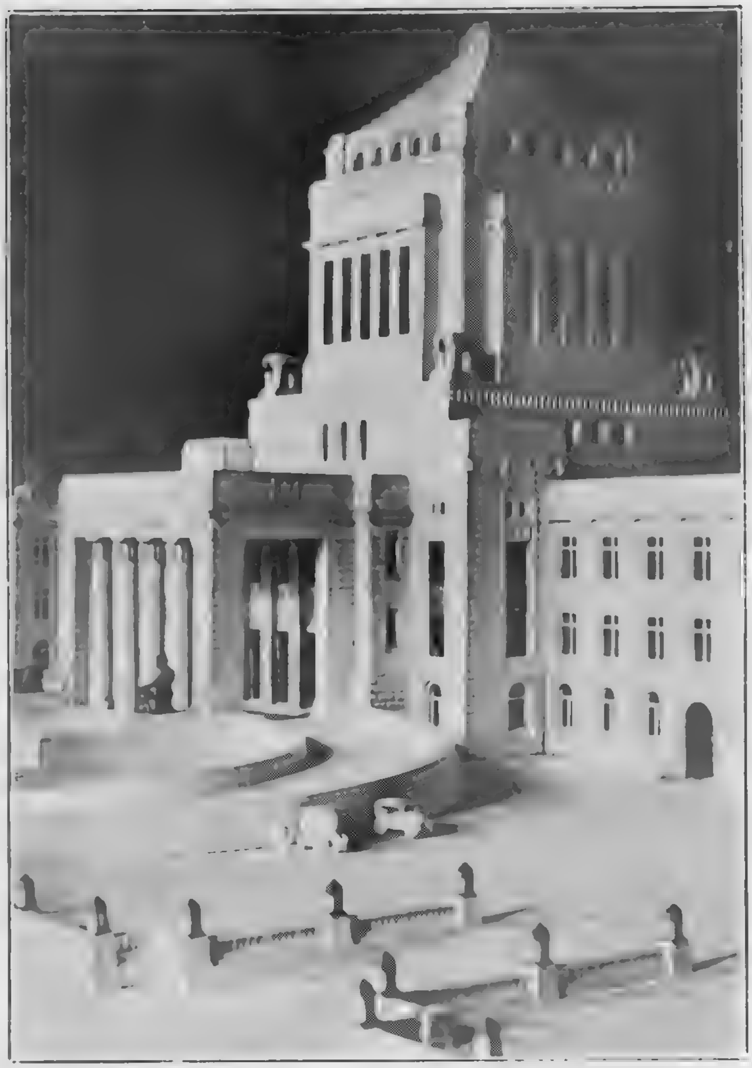


First Floor Plan of Japan's New Diet Building.

at Hibiya Park, comprising the Navy Department, the Ministry of Justice, and the Palace of Justice were erected; and in other quarters of the city the Department of Communications and the Department of Agriculture and Commerce, both destroyed by the fire.

One of the best modern buildings in Tokyo is the Bank of Japan, designed by Dr. K. Tatsuno. It is constructed in solid granite and of striking proportions and design, having a distinctly monumental character and unmistakably expressing its purpose as a national treasury. The Mitsui building at Suruga-cho, destroyed by fire, was a handsome building in brick, stone, and terra-cotta designed by the same architect.

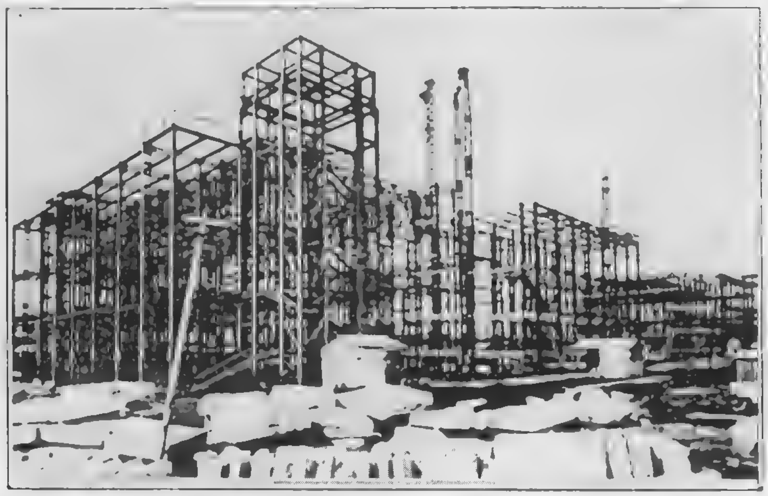
Among the private banks, the Murai Bank at Nihonbashi merits notice for its successful architectural treatment.


Japan's New Diet Building: The Central Tower and Main Entrance.

The Mitsubishi Company gave a great impetus to the construction of modern mercantile buildings by erecting large blocks within the open space called the Marunouchi, outside the moat of the Imperial Palace. This large area of open ground was made over by the Government some forty years ago to the Mitsubishi Company, who laid it out in a manner worthy of its fine position. The first large building block erected was that to contain the bank and offices of the Mitsubishi Company itself. This was quickly followed by other balancing blocks, some of which were taken by the leading shipping and insurance companies, and part forming rented offices for business firms. These buildings were designed by Dr. Tatsuzo Sone. The Tokyo Municipal building, or City Hall, occupies a fine site opposite to the Mitsu Bishi buildings. This is a brick and stone building with a large central hall and *flèche* after the style of the European town halls. It also was damaged during the quake, and is now undergoing extensive repairs. A new reinforced concrete structure of seven stories has been designed to take its place. Near to these buildings are the Chamber of Commerce, the Imperial Theatre, and the Metropolitan Police Offices—all fine buildings of their kind. The Imperial Theater was extensively damaged during the quake, while the Police Headquarters was so gutted by the fire and damaged by the quake that its walls had to be demolished by blasting.

The prevalence of earthquake necessitated considerable caution in the execution of solid buildings. The architects hesitated to attempt buildings of excessive height, and additional precautions, such as would hardly be deemed necessary elsewhere, have been taken against the possibility of the structures being subject to violent shock and vibration. The steel skeleton frame, bedded in the solid walls to tie the building together, has been used in many of the important buildings, such as the Bank of Japan, the buildings of the Imperial Household and the Mitsui Head Office. The Imperial Theater and the Mitsubishi building have heavy steel frames.

Excavating for the Foundations of the New Parliament House.

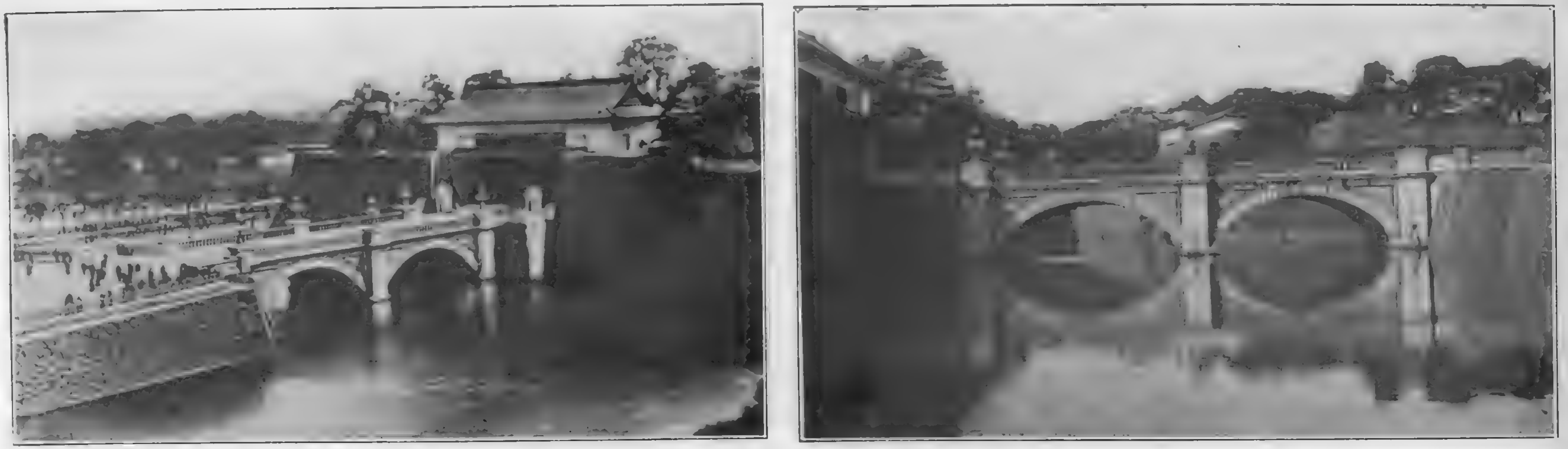

Present State of Steel Work.

The result of this progress in utilitarian architecture is to produce a medley of buildings in different styles, all foreign to the country and hardly consistent with a national type of architecture. The same, however, may be said of the modern cities of European countries, where all the Western styles of design are promiscuously used side by side.

Various attempts have been made in Japan to impart somewhat of a national character to modern buildings by introducing forms and details of design copied from the ancient wooden buildings. Most of such ornamental features are unsuited to a solid material like stone or brick. But besides this, these decorative forms are too intimately associated in the minds of the people with ecclesiastical art to appear anything but inappropriate when applied to secular buildings.

The Japanese architects have made gradual but steady progress in mastering the principles of western architecture, displaying splendid skill and originality in design, which in many instances achieves perfection. The Akasaka Palace, home of the Crown Prince and Regent, is one of the best examples of foreign architecture designed by Japanese architects and erected under their supervision.

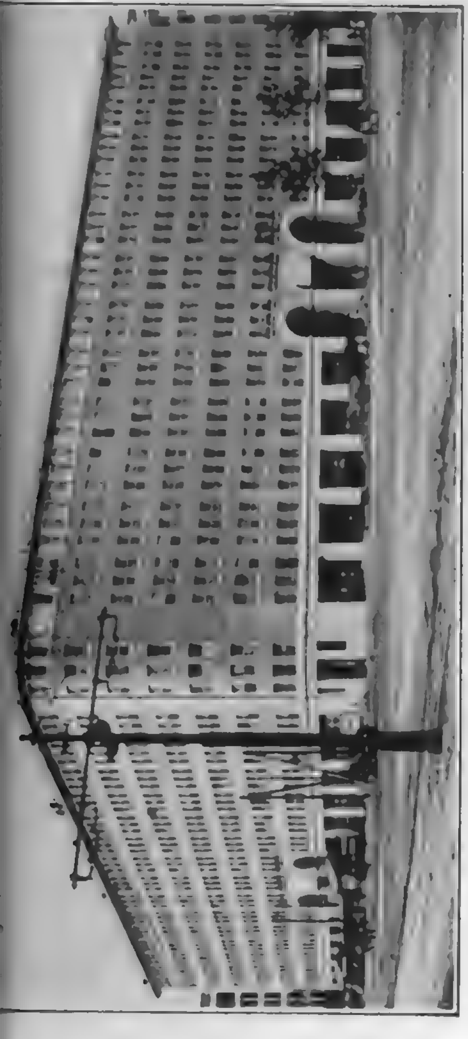
GATES TO IMPERIAL PALACE, TOKYO



Main Entrance Gate and Bridges to the Imperial Palace at Tokyo

The "Kikyomon" (Side Gate) of Imperial Palace

The "Otemon" (Side Gate) of Imperial Palace

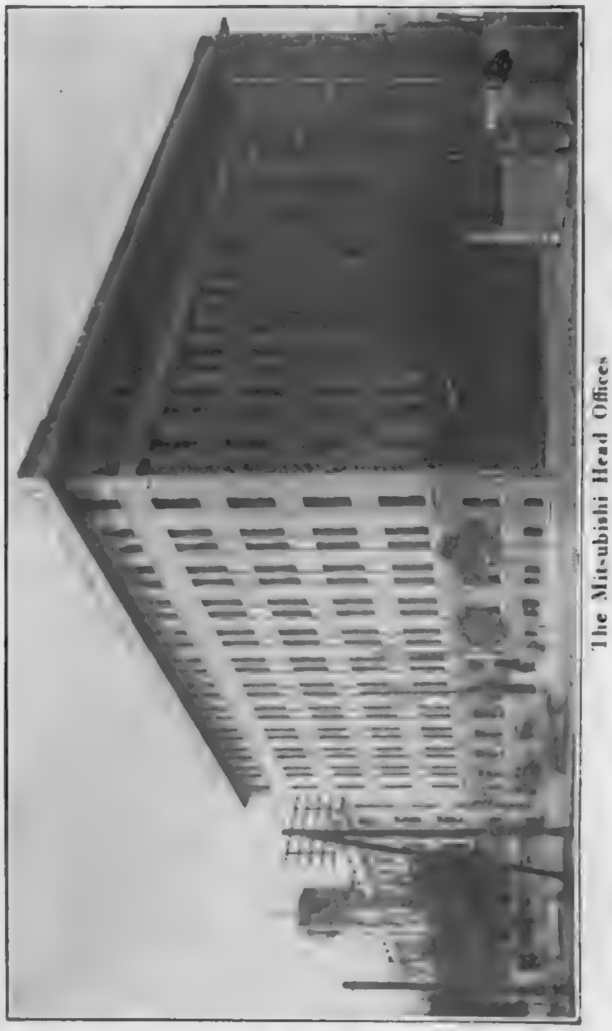


The Manunouchi (Mitsubishi) Office Building

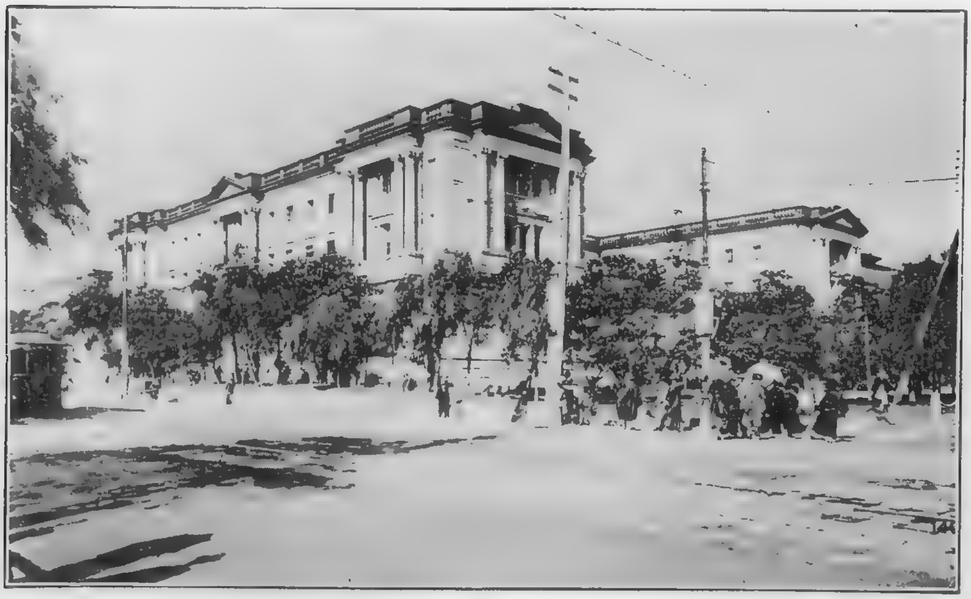
The Nippon Yusen Kaisha Head Office

The Tokyo Central Railway Station

The Tokyo Kaijo Building



The Mitsubishi Head Offices



The Bank of Japan.

Court of Cassation and Department of Justice.

Babasaki Street, the Heart of the Marunouchi District. These Buildings were all Erected by the Mitsubishi Company and withstood the Quake without damage. Right-hand Building is the Tokyo Chamber of Commerce.

This palace is a magnificent structure of gray granite after the style of European palaces of the 17th century, but with all interior decorations true to Japanese art and ideals. Another striking building is the Tokyo Central Station, designed by K. Tatsuno and erected by the Obayashi Gumi. This is a steel and brick structure erected in 1910, which came through the quake without a crack. It may not measure up to the best architectural design, but it stood the test where other buildings failed.

From 1910 onward there was a marked improvement in the style of buildings erected in Tokyo, but no striking progress was made until the Great War ushered in an era of unprecedented prosperity and activity in all lines of business. The need for more room, and up-to-date and commodious offices to handle the increasing volume of business, forced a revolution in building methods, and with the influence of Europe cut off the Japanese turned to America and adopted our designs and construction methods to such an extent that the future capital of the empire will be for all practical purposes and outward appearances an American city. New steel and concrete office buildings, five, six and seven stories high, began to loom above the black-tiled roofs of the old city. Department stores, banks, shops and factories, all built to standard American practice, followed in rapid succession, and the bulk of the architectural and construction work was done by the leading Japanese architects and contractors.

The Ginza, or main shopping thoroughfare of Tokyo, began to assume more and more a Western appearance. The old-style Japanese shops were rapidly displaced either by entirely new buildings or by remodelling their fronts and putting in plate-glass show windows. At the time of the earthquake and fire the entire Ginza had been transformed into a Western shopping street, though in many instances the old Japanese buildings had simply been camouflaged by imitation foreign fronts of stucco, tile or brick. At the same time, large and imposing office buildings began to make their appearance along this thoroughfare and the side streets of the Nihonbashi district. Several department stores followed the lead of the Mitsukoshi, and many banks, flushed with war-time profits, gave a further impetus to new building along the Ginza. These department stores, with their imposing plate-glass show windows dressed with the artistic genius of the Japanese, are every bit as attractive as those along Fifth Avenue in New York. One of the most up-to-date structures along the Ginza is the new building of the Chiyoda Life Insurance Company, containing the offices of many prominent firms, with the two lower floors given over to the temporary use of Iida & Company's great Takashimaya Department Store. This building was somewhat damaged by the fire, but a new facing has been chipped on the blistered stone, restoring its perfect appearance.

Another building which attracts considerable attention on the Ginza above the Mitsukoshi Department Store is the new Tokyo main branch of the Yamaguchi Bank, a handsome structure erected by the Takanaga Komuten.

As a result of the great earthquake and destruction of property along the main business street of Tokyo, an association of merchants has prepared a building program for the reconstruction of the business edifices along the

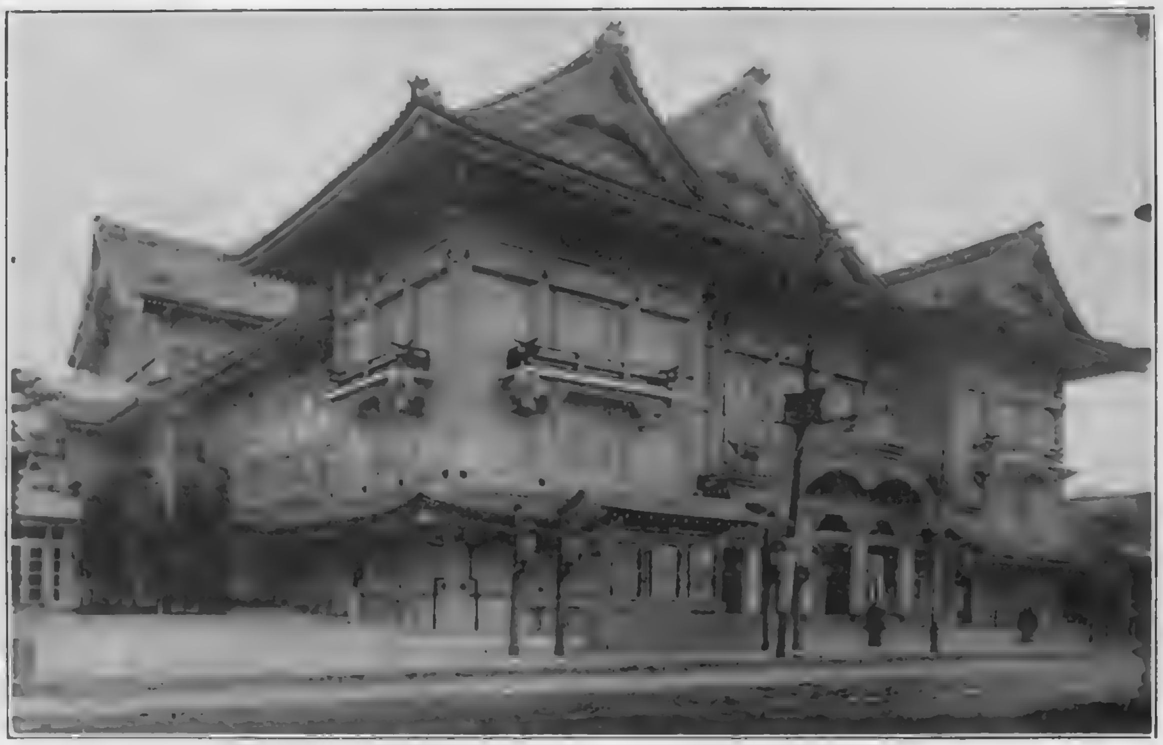
THE KABUKI THEATER, TOKYO'S MOST BEAUTIFUL BUILDING

A Dream of Old Japan in Modern Steel and Concrete

Erected by the Obayashi Gumi, Building Contractors

The Boxes

Orchestra Stalls and Galleries



Reminiscent of Old Japan: The Beautiful Exterior of the Kabukiza

The Commodious and Comfortable Corridors and Lounge

Nippon Oil Building

Railway Association Building

THE MARUNOUCHI DISTRICT

Left: Tokyo Prefectural Government Building; Background, "Hochi Shimbun." "Tokyo Nichi Nichi" Building

Ginza between Shimbashi and Kyobashi. The plan is necessitated by the fact that the present temporary buildings have to be replaced by steel and concrete structures not later than August 31, 1928, in accordance with the regulations issued by the Government for the reconstruction of the capital.

The officers of the Merchants' Association are said to be seeking foreign capital for their project. To this end they have submitted their plan to Ambassador Matsudaira at Washington through Mr. Junnosuke Inouye, former Minister of Finance, in an effort to get in touch with American financiers who might be interested in the scheme.

The Nagai Office Building: A Handsome Reinforced Concrete Structure which collapsed during the Earthquake, when only half-finished

According to the Government building regulations, about 50 acres of land along the Ginza, on both sides, will be affected by the reconstruction program. The Merchants' Association proposes to erect about 25 buildings, each on a lot 120 by 60 feet. These buildings, as mentioned, will be steel and concrete, 5 stories, each to cost about Y.2,400,000. The total amount of Y.60,000,000 is to be obtained abroad. The financial plan calls for the issue to mature in 20 years.

The New Parliament Building

The dominating figure of Tokyo will be the Parliament

House, a magnificent site for a group of Government buildings that will be erected later on in its immediate vicinity. This imposing pile of steel, concrete and cut granite will arise from the highest ground (90 feet above sea-level) in the center of the capital near the Sakurada Gate of the Imperial Palace. The designing and construction carried out by the Government architects under the Department of Finance is evidence of an architectural awakening and a determination to be freed from the monstrosities which foreign architects imposed upon the Japanese during their earlier contacts with European art. The structure calls for an expenditure of Y.20,000,000, spread over a period of twelve years, the beginning of a program that includes the erection of buildings for the Departments of Home Affairs, Foreign Affairs, Finance, Navy, Education and Commerce and Agriculture, the whole forming an Imperial Government center which will do credit to the position of Japan as a great

The Kuhara Head Office Building: Type of Monolithic Reinforced Concrete Structure, Free from Excess Ornamentation, which withstood the Earthquake without the Slightest Damage

Katakura Silk Spinning Company's Building in Tokyo, erected by the Shimizu Gumi.

Toyama Industrial Library in Shiba, Tokyo, erected by the Shimizu Gumi.

The Finance Department, having supervision over the construction of new Government buildings, has prepared a budget of Y.200,000,000 with which to build nine new department edifices over a period of ten years. The share for the fiscal year 1926, to be included in the next budget, is estimated at between Y.10,000,000 and Y.15,000,000.

Three buildings are most urgently needed, and the Government plans to complete this group in the first three years, the construction of the second group to start immediately afterwards with the same time allotted, and the third group to be completed before 1926.

The Construction Section has been negotiating with the other Departments of the Government with a view to obtaining their ideas on the plan of the buildings. The drafting of the buildings is to be completed in July, and if the budget is approved at the next regular session of the Diet, the work will be started immediately thereafter. The entire building pro-

The Tokyo Branch of the Bank of Chosen, erected by the Shimizu Gumi: Architect, Dr. M. Kuzunishi

by the sale of Government properties. It is planned to dispose of real estate to the value of Y.15,000,000,000 for this purpose during the course of 1925 and 1926.

The new Parliament house, set in the middle of a park site covering 87,000 square yards, will have an area of 14,984 square yards, with some 60,000 square yards of floor area. Exclusive of the basement there will be three stories, with a frontal of 678 feet and a width of 294 feet. The height from the ground to the roof will be 69 feet, and 216 feet to the top of the central tower. There will be 361 rooms, to be used by the members of the House of Peers and the House of Representatives. The House of Peers, covering 840 square yards, will seat 500 members, with provision for 580 and a gallery capacity of 968 seats. The House of Representatives will cover the same area and will also seat 500, with provision for 630 and a gallery seating for 1,137 persons. Great attention was paid to the foundations, the contract for which was awarded to the Oriental Compressol Company. Mechanical excavators were employed in excavating for the foundations and pile clusters driven to make the bed for the concrete pedestals. The steel frame will be finished with brick walls and faced with cut granite. All floors, roof and partitions will be of reinforced concrete.

Entrance to the Okawa-Tanaka Building, another Monolithic Reinforced Concrete Structure that successfully withstood the Quake; A Shimizu Gumi Building

Like so many other important public undertakings started some years ago, the original construction estimates have undergone considerable expansion, due to the increased costs of materials and labor. The building as originally designed called for an outlay of only Y.7,500,000, spread over the ten-year period 1918-1927. In 1923 the site was greatly increased and the estimates brought up to Y.20,000,000, and the date for completion set for 1930. The earthquake and the attendant calls on the treasury for more urgent construction compelled a still further pruning down in the annual allotments for the Diet building, and its completion is now postponed until 1934. By March of this year the foundation work had been practically completed and about six per cent. of the steel work erected.

The Mitsubishi Bank

After the Parliament building comes the classic Greek structure which houses the Mitsubishi Bank. This is undoubtedly the most beautiful modern business structure in Japan and one of the finest of its kind in the world. It stands in the

Main Banking Office of the Toyko Branch of the Bank of Chosen

center of the Marunouchi district, the gem of the many handsome edifices erected by the Iwasaki interests. This building was designed by Dr. Kotaro Sakurai, a noted Japanese architect, and erected under the direct supervision of the Mitsubishi Estate Department at a cost of Y.3,000,000. Although the proposed Mitsui Building and the new executive offices of the Yokohama Specie Bank will be larger, costlier and more imposing, it will be difficult for even these magnificent structures to surpass in impressive dignity the lines of this example of classic Greek architecture. This building is described and illustrated elsewhere in this number of THE FAR EASTERN REVIEW.

Magnificent New Office Building of Takata & Company, Tokyo

The Kabukiza Theater

By far the most beautiful building in Tokyo is the new Kabukiza Theater, which embodies the finest traditions of Japanese architecture carried out in steel and concrete. In this temple of art, famous in the history of Japanese drama, the architects have fully and ably demonstrated the adaptability of the pure Japanese building lines to modern practice. Rejecting the meretricious and over-decorated architecture of the Tokugawa period and the finer types of the Kamakura and Kyoto epochs, the architects have carried us back to the massive style that characterized the original Sino-Korean structures which first made their appearance in Japan at Nara. Several of these structures still stand as monuments to the art and technique of a bygone age when China and Japan were the most highly civilized countries of the globe.

In the majestic lines of the sweeping roof, the ordered symmetry of its curves and solemn harmony of exterior composition combined with the wonderful power and splendor of interior decorative art, the architects have succeeded in reproducing in steel and concrete a fire proof and earthquake proof temple that will stand as a permanent monument to the genius of the Japanese people, in strict keeping with their best traditions and ideals. The building is unique in

Life Insurance Association Building

Bank of Taiwan, Ltd.

The Bankers' Club

The Chiyoda Building

The Yamaguchi Bank at Nihonbashi

The Beautiful Tokyo "Kaikan," or Palace Hotel, now being repaired by the Shimizu Gumi

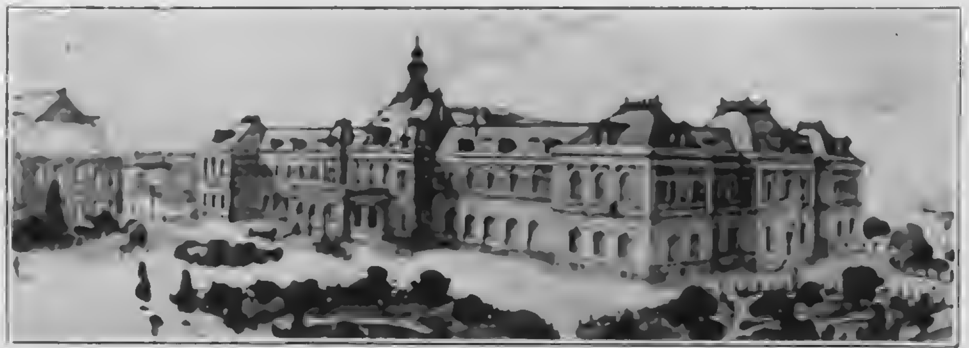
Japan, where the craze for imitation foreign-style houses closed the eyes of the people to the beauty of their own dignified architecture. The museum in the Meiji Memorial Park was the first modern building erected in Japan along these lines, but its one-storey architecture and lines are more reminiscent of the palace buildings of Peking than of the historical structures at Nara and Kyoto.

Work on the new theater was commenced in June 1922 and was nearing completion when the earthquake and fire devastated the city. The building withstood the earthquake shocks, but the conflagration which laid the surrounding district in ashes swept through the open windows and completely gutted the interior, leaving only the empty shell of steel and concrete. Patiently setting to work again, the building was once more finished and furnished, and in December 1924 thrown open to the public.

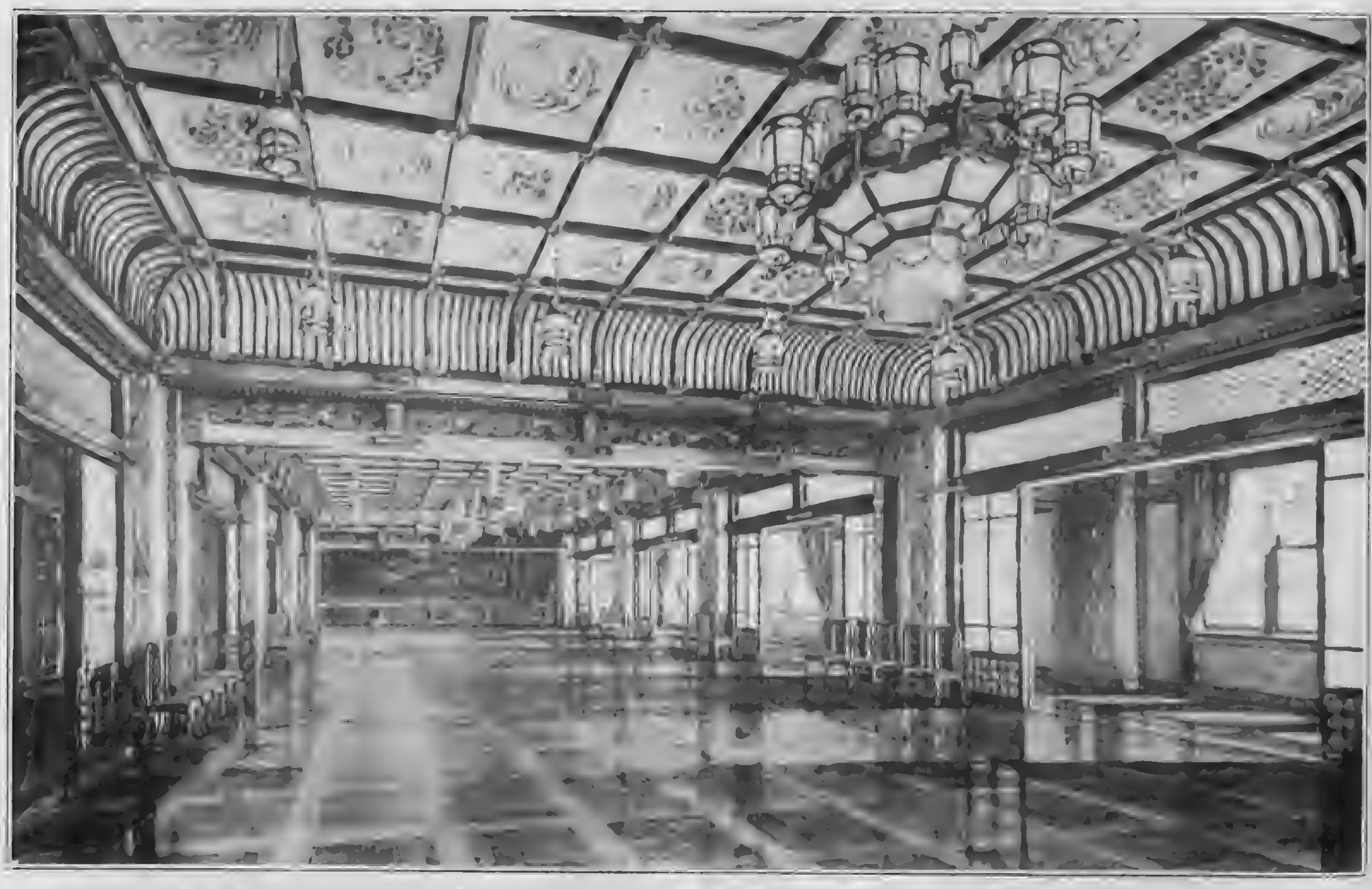
The building is 100-feet high, covering a site of 81,000 square feet, with a main floor area (orchestra and boxes) of 32,760 square feet. The dress circle has an area of 16,398 sq. feet, the family circle 15,422, and the gallery 7,084 square feet. The seating capacity of the theater is 2,296. The main stage, one of the largest in the world, is 144-feet wide and 72-feet deep, the back stage and wings covering 3,600 square feet. An outer revolving stage, 60 feet in diameter, operated by electricity, carrying a smaller hand-operated revolving 40-feet stage, forms part of the main stage equipment. The main stage can be elevated or lowered by means of electric motors. The dressing-rooms, covering 10,304 square feet on two floors, are perhaps the most comfortable and best fitted in the world. As Japanese performances last for eight to ten hours, a dining-room on each floor is provided for the actors.

The interior decorations, while sumptuous, are in strict keeping with the severe simplicity of Japanese architecture. Color effects have been worked out after the best style of temple decoration, and the effect is heightened by plain cypress wood paneling and trim. The lobbies are wide and the ceilings high, giving the appearance of great space. The lounge rooms are also commodious and comfortable, with a special room where children can be safely kept and amused while the parents enjoy the play. Ventilating apparatus

Ball and Banquet Room of the Tokyo Palace Hotel cools or heats the air as needed, and a steam-heating plant maintains an even temperature in winter. The construction of this building was carried out by the well-known building contractors, the Obayashi Gumi, to the design of Mr. Shin-ichiro Okada, Professor of Engineering at the Waseda University. The cost of the building is stated to be Y.2,700,000, of which Y.1,700,000 is in the building itself, Y.300,000 in its electrical equipment, and Y.700,000 in furnishing and decoration.



The Tokyo City Hall, opposite the Mitsubishi Park, in the Marunouchi District



The Japanese-style Banquet Hall and Concert Room of the Tokyo Palace Hotel, copied from the Nijo Imperial Palace at Kyoto

The influence of this building on the reconstruction of Tokyo may be very great if other builders and architects take heed of the possibilities and practicability of building permanent structures in pure Japanese style. Such buildings are not always practicable for offices and business purposes, but there is nothing to prevent the *motif* being carried out in official and public buildings. A return to the pure Japanese style for such exteriors would enhance the beauty of Tokyo a thousandfold and make the new capital unique amongst the cities of the world.

The Imperial Theater and Palace Hotel, now combined under One Ownership

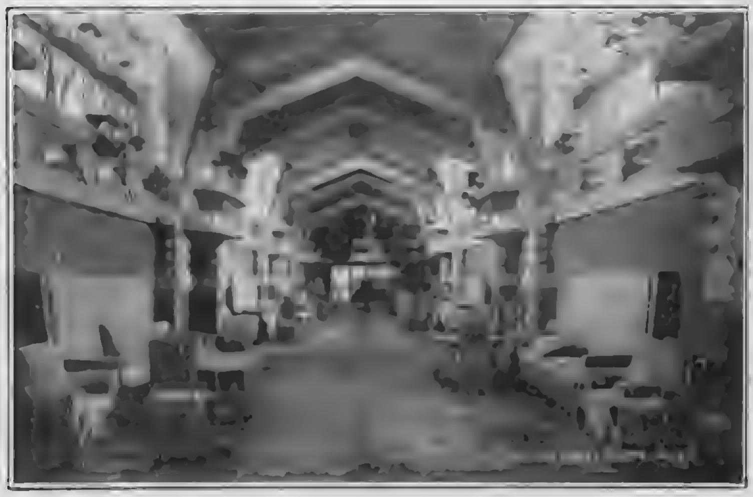
The Marunouchi Group

Marunouchi, the business heart of the capital and the financial center of Japan, has been reserved in the Reconstruction and Town Planning Programs as an exclusive fire-proof district. Within its limits only stone, steel and concrete materials may be employed in construction, and as a consequence many fine office buildings have already been erected and as many others projected. Much of this valuable property is owned by the Mitsubishi estate, and it is largely due to their initiative and steady program of improvements that this section has been transformed into the most modern part of Tokyo. The Iwasakis, like the Astors in New York, have specialized in

Entrance Hall

Main Lobby

Main Entrance from Hibiya Park Side



"Peacock Alley"

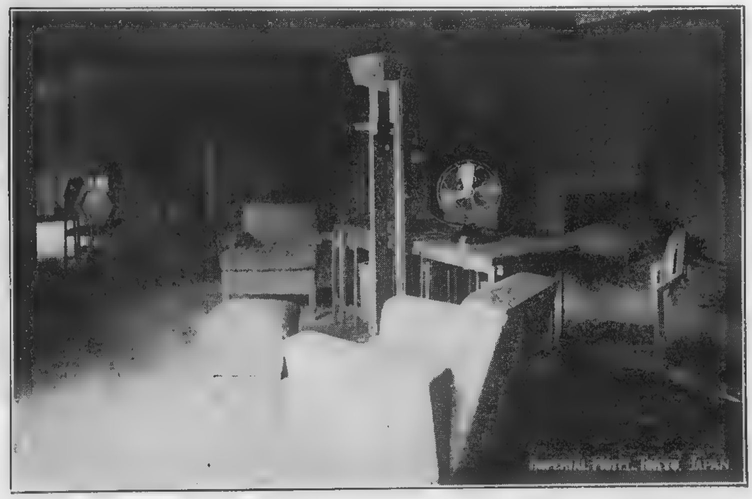
One of the many Verandahs

THE IMPERIAL HOTEL AT TOKYO.

Tokyo real estate, until at the present time they own 4,308,431 square feet of urban property, of which 2,490,919 square feet is located in the Marunouchi district, immediately in front of the Tokyo Central Railway Station and extending along the east side of the Imperial Palace grounds facing the moat and park. Here are over forty modern buildings containing the offices of more than eight hundred commercial firms and other organizations, with special buildings erected by such influential concerns as the Nippon Yusen Kaisha, Tokyo Marine Insurance Company, Nippon Oil Company, Furukawa and Kuhara Companies, Yokohama Specie Bank, Taiwan Bank, Chosen Bank, Tokyo Chamber of Commerce, Imperial Theater, Bankers' Club. Industrial Club, Sale & Frazar, Industrial Bank of Japan and the various Mitsubishi offices.

Mitsubishi Head Office

The center of this group is the headquarters building of the Mitsubishi companies, devoted exclusively to the business of this immense organization. Here are the executive offices of the Mitsubishi Goshi Kaisha, the central holding company, which, in addition to exercising direction over the several individual companies belonging to the consortium, supervises the general, personnel, intelligence, economic research, accounts and estate departments. Under this one roof are grouped the executive offices of the combination of companies known as the Mitsubishi Consortium, which, with the holding company, are capitalized at Y.395,000,000. Here is the office of the Mitsubishi Shipbuilding and Engineering Company, Ltd., capitalized at Y.50,000,000, operating the great shipyards at Kobe and Nagasaki; the Mitsubishi Iron and Steel Company, Ltd., with Y.25,000,000 capital, operating steel and iron works at Kenjiho, and various mines in Korea: the Mitsubishi Warehouse Co., Ltd., a Y.10,000,000 enterprise owning huge bonded warehouses at Tokyo, Yokohama, Kobe, Osaka and other points in Japan; the Mitsubishi Trading Company, Ltd., with branches in all the principal cities of the world, which not only handles the great import and export business of the consortium, but engages



A Guest Room

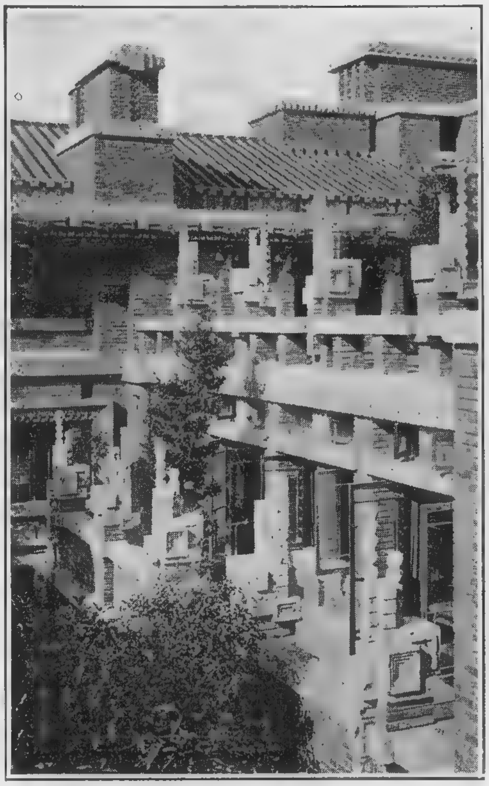
Main Dining Room

in manufacturing and in operating steamship lines. This concern alone purchases over $50,000,000 of American products yearly. Then there is the Mitsubishi Mining Company, Ltd., capitalized at Y.100,000,000, operating 15 metal mines, 12 coal mines, smelters, a refinery, a coke works and a laboratory. The Mitsubishi Internal Combustion Engine Company, a Y.55,000,000 enterprize, specializes in the manufacture of aircraft, aero-engines, Diesel engines and automobiles, and the Mitsubishi Electrical Engineering Company, with Y.15,000,000 capital, manufactures generators, motors and other high-class electric machinery. The Mitsubishi Marine and Fire Insurance Company, with a capital of Y.5,000,000, is kept busy looking after the business of the consortium.

Marunouchi Building

The Mitsubishi Head Office building is overshadowed by its immediate neighbor, the eight-storey Marunouchi building filling the entire block directly in front of the Tokyo Central Station. This building was also erected by the Mitsubishi Estate Department to the design of Dr. Kotaro Sakurai, the architect of the Mitsubishi Bank. It enjoys the distinction of being the largest and most up-to-date office building in Asia, having 643,000 square feet of floor area divided into 350 offices. The main halls forming an arcade on the ground floor are lined on both sides with some forty high-class shops, and on the street sides there are twenty or more stores with ample show window space, making the building one of the most popular shopping centers of the city. From the many and varied interests encompassed within its walls the building is now the most favored one in Tokyo. More than 50,000 people cross its thresholds every day.

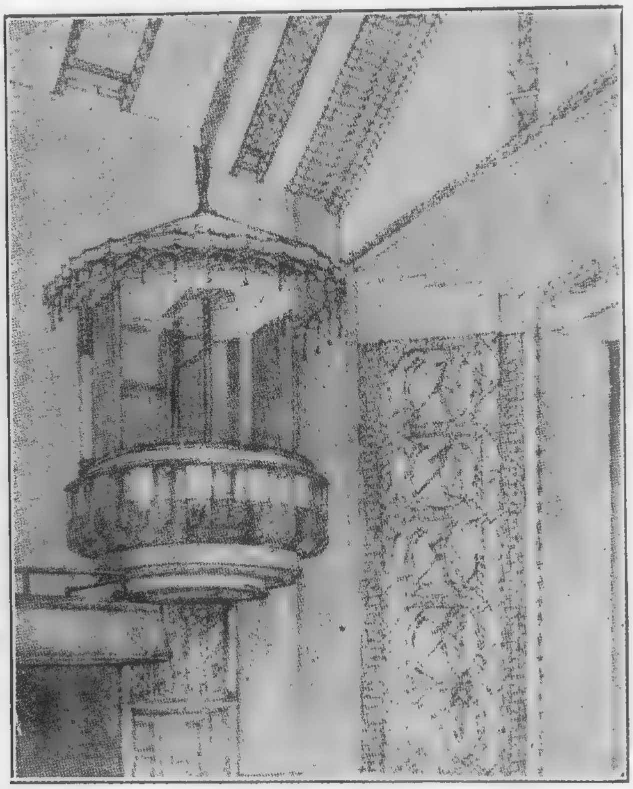
View from the Roof



Detail of Balcony Construction

This building is one of four large office structures erected by the Geo. A. Fuller organization of New York working in conjunction with the Japanese. Due largely to the initiative of the late Baron Kondo, president of the Nippon Yusen Kaisha, this great firm of American builders was induced to come to Japan and form an American-Japanese concern called the Geo. A. Fuller Company of the Orient, Ltd., for the express purpose of erecting the Marunouchi, Yusen and Japan Oil buildings, at the same time teaching the Japanese the most advanced methods of construction in order that they might carry on alone the campaign of modernizing their cities with efficiency. A complete American organization was taken to Tokyo, and amongst the personnel were several Japanese architects and builders who had been studying American building methods, and a large number of Japanese engineers and construction experts subsequently joined the organization on the ground. These men quickly assimilated American ideas, displaying no desire to cling to tradition in architectural *motif* or engineering methods, and as a result acquired an experience that is enabling them to carry on the modern steel structural work now in evidence on all sides.

The Marunouchi Building, 300 by 350 feet, is eight stories high, of structural steel, with reinforced concrete arches and cement floors. The exterior consists of a granite base, succeeded by a storey of architectural terra-cotta, and above that by six stories of brickwork faced with Japanese finishing tile. The upper storey is of cement stucco work. The cost of the building was approximately Y.10,000,000. The earthquake developed several weaknesses in design and caused considerable superficial damage to the palstering, walls and outside tile finish. As a consequence of the lessons learned as the result of



THE NEW SHIMBASHI MUSIC HALL IN TOKYO

Top: Exterior View and Corner of Stage. Left: Detail of One of the Several Lounge Rooms

the quake, the tile finish on the outside has been completely stripped off, and at present the building above the second storey terra-cotta line is finished in cement plaster.

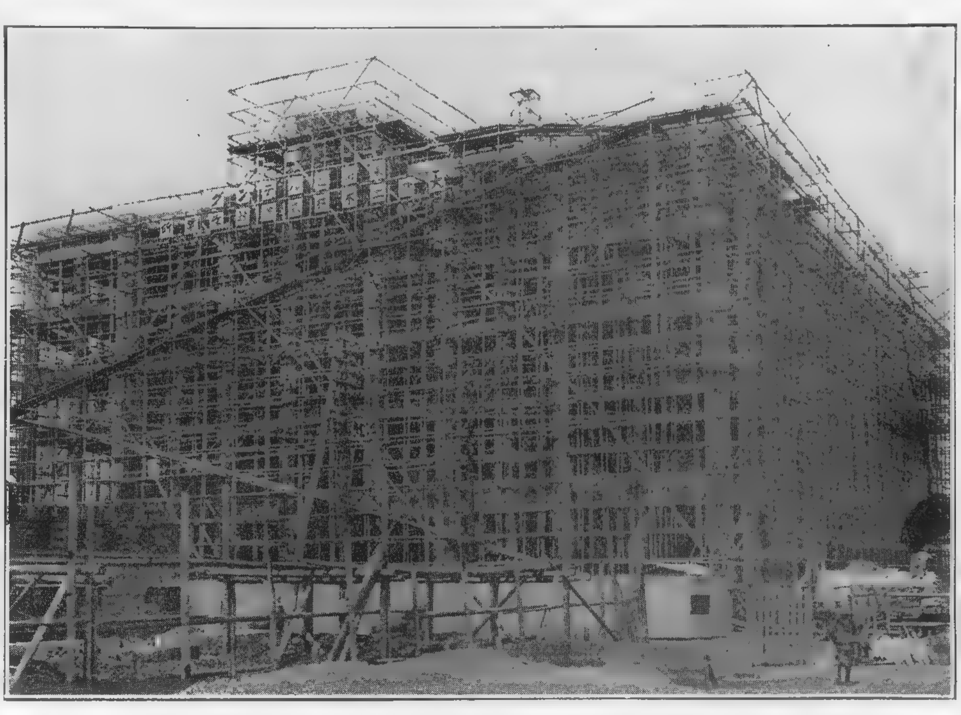
Alongside of the Marunouchi building stands the smaller but equally imposing head office of the Nippon Yusen Kaisha, another building erected by the Geo. A. Fuller Co. of the Orient, to the design of the architects, Sone & Chujo, at a cost of Y.6,000,000. This is a seven-storey structure, covering a site 160 by 300 feet, built of steel, with reinforced concrete arches, cement floors and architectural terra-cotta exterior above a granite base. The total floor area is 312,578 square feet. The other building erected by the Fuller combination is a seven-storey office structure of skeleton steel construction, with reinforced floor arches and cement floors, for the Japan Oil Company to the design of Sone & Chujo, architects. The cost was Y.3,000,000.

Across the broad avenue from the Nippon Yusen Kaisha office is the Tokyo Marine Insurance (Tokyo Kaijo) Building, another handsome office structure which came through the quake with only superficial damages. Many other modern buildings have been erected in this district along lines that will make of it in the future a replica of the financial centers in any large western metropolis.

Mitsubishi Building No. 28

Among the new additions to the handsome group of financial structures in the Marunouchi district represented by the Yokohama Specie, Taiwan, Chosen, Yasuda, Industrial and Mistsubishi bank buildings, is the new six-storey and basement reinforced concrete Mitsubishi Building No. 28, which will be ready for occupancy in the spring of 1926. This building will have a floor area of 47,000 square feet, and the construction throughout will be earthquake and fire-proof. The first storey will be faced with granite, with pressed brick and stucco. Two passenger elevators will be installed, and each floor will be fitted with mail chutes, toilets and fire-extinguishing nozzles.

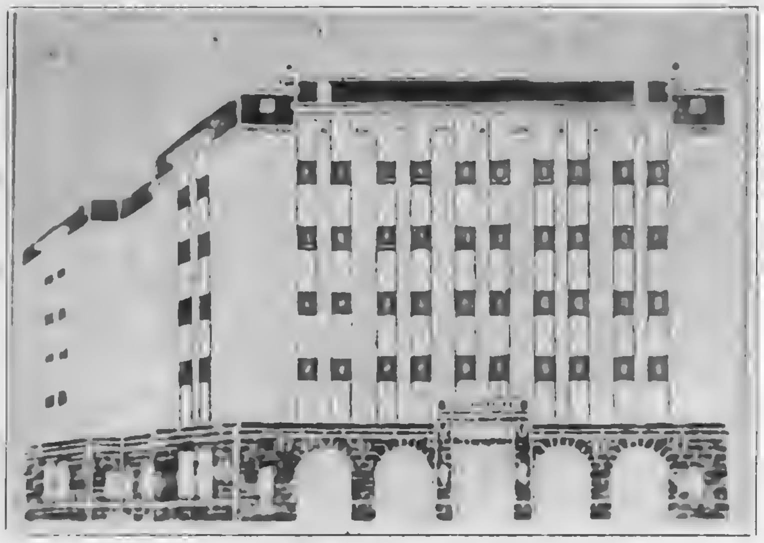
Amongst these handsome financial structures are those housing the Industrial Bank of Japan (described elsewhere in this number), the Yasuda Bank, the Tokyo Branch of the Bank of Chosen, and the temporary executive offices of the Yokohama Specie Bank. The six-storey Bank of Chosen, erected by the Shimizu Gumi, is a steel skeleton reinforced concrete building faced with granite and white stone, with 5,276



New Head Office Building for the Oriental Development Company in course of erection by the Okura Building Company, Ltd.

The Kyocho Assembly Building: A Massive Reinforced Concrete Structure erected by the Okura Building Co., Ltd.

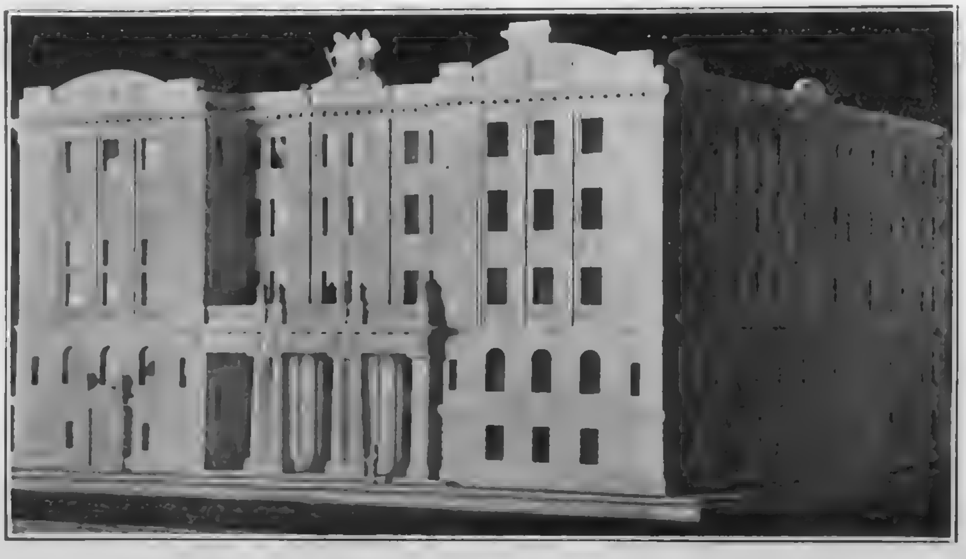
square yards of floor space. This is a splendid example of a modern building designed by a Japanese architect (Mr. M. Kuzunishi, Doctor of Engineering) which stood the quake without developing a crack or structural defect of any kind.



Rough Sketch of The Mitsubishi No. 28 Building.

Palace Hotel

One of the really handsome buildings which failed was the newly-completed Palace Hotel, known as the "Tokyo Kaikan," a palatial structure of five floors designed as a high-class social and entertainment center, and erected at a cost of over Y.3,000,000. During the quake the brick walls of the entire second storey were shaken out, throwing the full strain of the heavy upper floors on to the steel corner columns, which bent under the repeated shocks. For the past twenty months the building has been considered as dangerous, but engineers have reported that it can be repaired and strengthened in such a way as to make it absolutely safe in the future. Based on these recommendations, the Imperial Theater Company recently acquired the property and entrusted to the Shimizu Gumi (who built the original structure) the work of carrying out the repairs, which will take the form of bolting heavy steel beams to the corner columns and embedding them in a thick pillar of concrete.



Model of The New Industrial Club, opposite the Tokyo Central Station

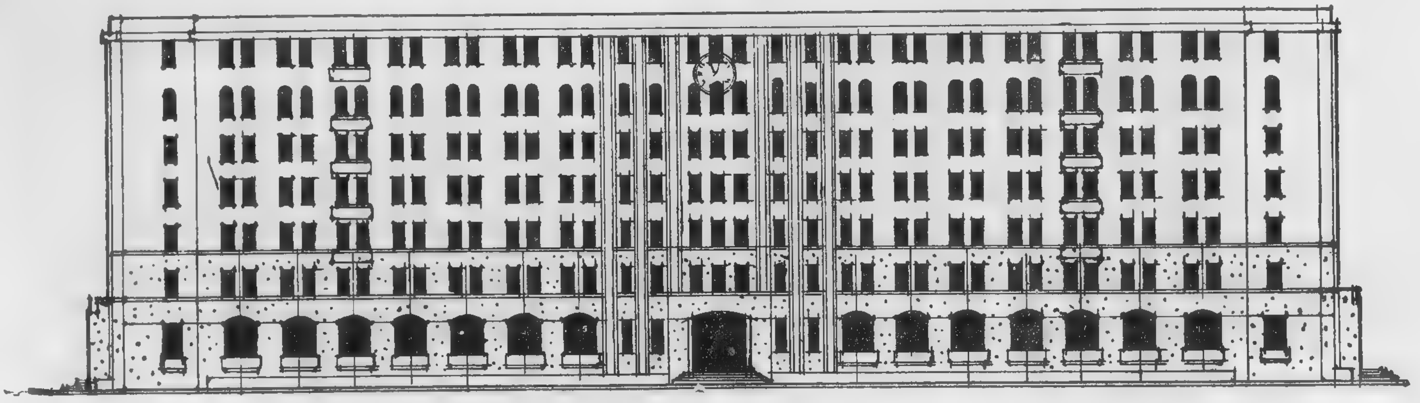
The interior decorations of this building follow the best traditions in Japanese art, with numerous Japanese-styled dining-rooms and a banquet hall in lacquer and gold to a design copied from the Nijo Palace at Kyoto. On the fourth floor there is also a foreign banquet hall in the French style, accommodating 1,500 persons.

The Imperial Hotel

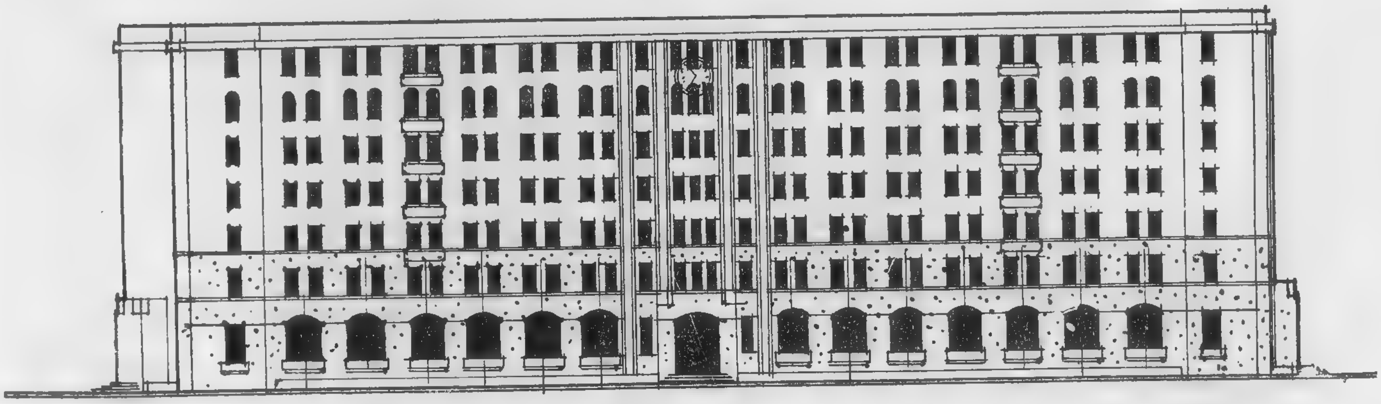
Probably no structure erected anywhere in the world in recent years has been the subject of as much controversy as the new Imperial Hotel, facing Hibiya Park, designed and erected by Frank Lloyd Wright of Chicago. Other architects and builders have scathingly criticized and condemned the building, while others of equal prominence have as enthusiastically praised its design and construction. The architect contends that the structure is "a clear, consistent statement of a more coherent idea, a stronger note in our modern life where unity and character come out of the nature of the thing done—in fitness to purpose; . . . . its simplicity and sincerity cannot fail to teach Japan a new lesson regarding Western civilization in aspects that are vital to that civilization itself."

This may be all true, but it is difficult for the layman to under-

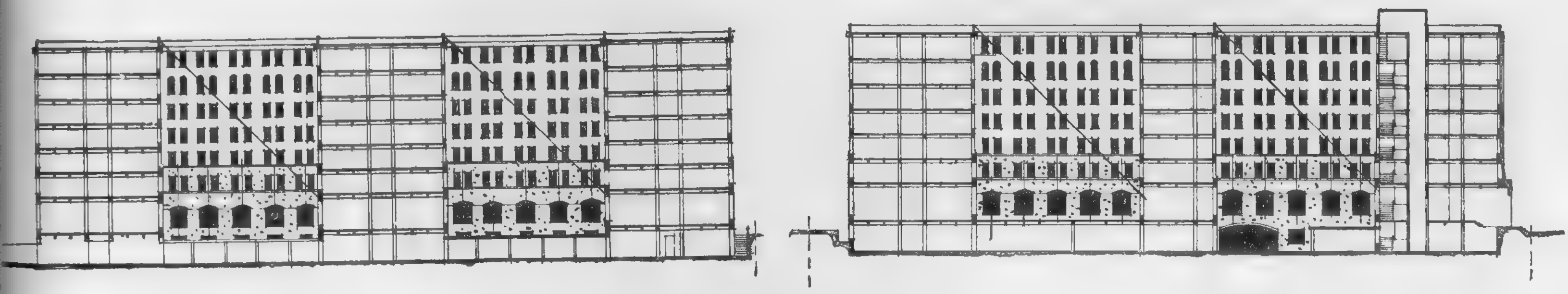
TOKYO'S NEW CITY HALL



FRONT ELEVATION



REAR ELEVATION



SECTIONS

stand what bearing the resurrection of the ancient Aztec, Toltec or Inca *motif* has on the vital aspects of our modern civilization, especially when it eliminates the furnishings our civilization exacts in a modern hotel. Undoubtedly the Imperial Hotel is one of the world's finest structures in point of character, which is all its own. It is not difficult to recognize the genius which conceived such a poem in stone and brick, and due praise must be spontaneously offered to the brilliant engineering talent which adhered to strictly straight lines and flat arches throughout the entire building. The only fair comment that can be advanced is that the building is probably a hundred years ahead of the age in its architectural features and fifty years behind in many things which make for the comfort of its patrons. The architect sacrificed everything to his art, raising a monument to his genius and bequeathing to the Japanese the difficult task of making it a financial success.

The building, however, nobly stood the test, and whatever its drawbacks, both Japanese and foreigners have reason to render profound thanks that it was completed before the earthquake. Its splendid theoretical structural design worked out practically when the terrific shocks violently jolted the building. It trembled, swayed and rocked in the upheaval, and at its ending quietly steadied to position free of distortion, rents, cracks or damage of any kind. Through all the subsequent tremors it remained a haven of refuge to those who enjoyed its hospitality.

New American Embassy

Since the earthquake the American Embassy has been located in the front rooms of the north wing of the Imperial Hotel, and it is gratifying to Americans and Japanese alike to know that the American Government will erect a new Embassy and Consulate in Tokyo to take the place of the old wooden building destroyed in the conflagration. The project is a gesture of America's sincere friendship for Japan, and the buildings are to be on a scale commensurate with the finest premises maintained by any other Government in a foreign capital. The buildings will be earthquake and fire-proof, and the plans provide for an Embassy office and staff quarters as well as a suitable private residence for the Ambassador. A separate plot of land is to be acquired for the erection of a Consulate-General building.

The Imperial Household Department has ceded the Prince Ito property to the United States as long as that country desires to use it for Embassy purposes. The property adjoins the present American Embassy grounds in Reinanzaka, and the grant increases nearly 50 per cent the area of the old Embassy grounds.

The grant is similar to that under which the present American Embassy grounds are now held, except that the new order is from the Imperial Household Department instead of the Japanese Government. Congress recently appropriated $1,250,000 for new Embassy buildings and a new Consulate in Tokyo. Of this, it is

THE GINZA, TOKYO'S MAIN THOROUGHFARE

Looking North and South from the First Mutual Life Insurance Building.

Looking North from Nippon Bridge.

The Matsuzaka-ya Department Store.

The Tokyo Branch of the Sumitomo Bank, near the Ginza, was saved through the heroism of five faithful employees who, at the risk of their lives, stayed inside the structure to close the fire shutters with which the windows were equipped. As the flames had surrounded the building they were compelled to remain inside three days

understood, approximately $1,000,000 is for the Embassy and the other quarter of a million dollars is for the Consulate.

The letting of contracts and all other details concerning these buildings will be handled by the State Department in Washington.

There is to be one central Embassy building and several other buildings which will be the homes of all persons connected with the American Embassy in Japan.

The Temporary Quarters of the Shirokiya Department Store in Nihonbashi, Tokyo

New British Embassy Group

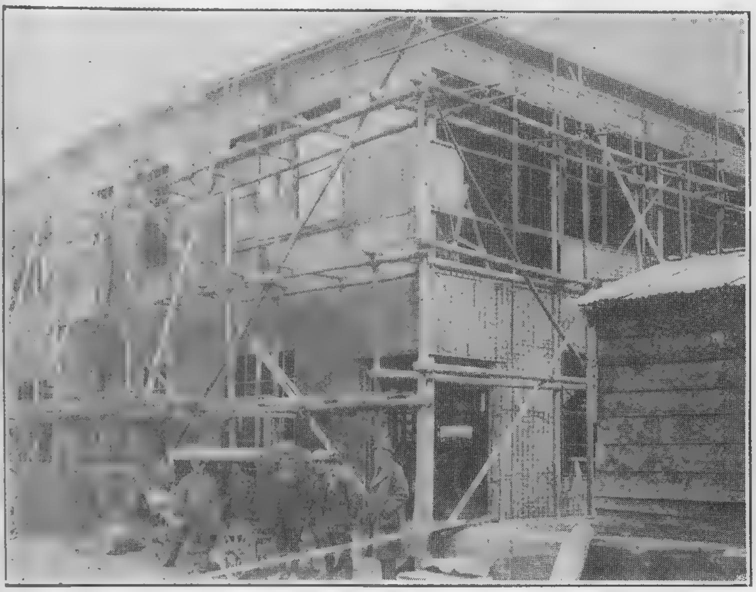
The British Government has also prepared a provisional estimate of £300,000 for the erection of a new group of Embassy buildings in Tokyo. The old buildings are to be replaced by eleven separate residences, besides an office block and several quarters for the staff.

The buildings will be designed to resist a seismic co-efficient of one-quarter gravity, or a horizontal acceleration of eight feet per second, which factor is considered adequate in the structural design of the buildings to make reasonably safe provision against the effects of severe earthquakes.

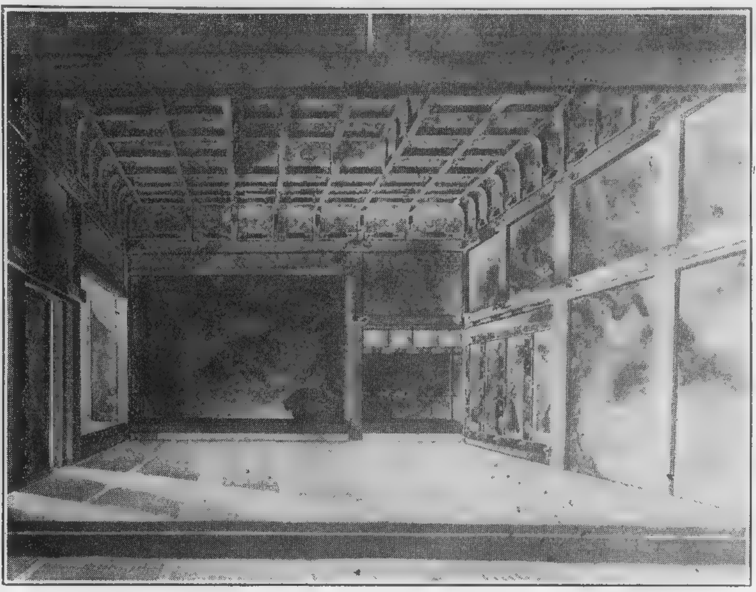
The system of construction for the buildings will be that of monolithic reinforced concrete throughout, not only as regards the structural frame of the building, but as regards wall panels, partitions, floors and roofs. The reinforcement will be continuous throughout; the lay-out of the buildings will be designed to give the maximum rigidity by the provision of the most effective sway-bracing through the whole of the blocks.

The limitations imposed on the design of the building by the nature of the structural problem will inevitably demand a design of some unusual features. It will, for instance, be essential to aim at a minimum of external projections, and detachable external surfaces will also be eliminated. The constructions will probably be treated as moulded buildings, formed of plastic material such as concrete, with decoration in the form of stamped patternings, panels, recesses or other methods of design adapted to the proper functioning of the material. Roofs will probably be flat, and it is proposed that no part of the buildings shall be of a greater height than two storeys, nor will they exceed 110 feet in length.

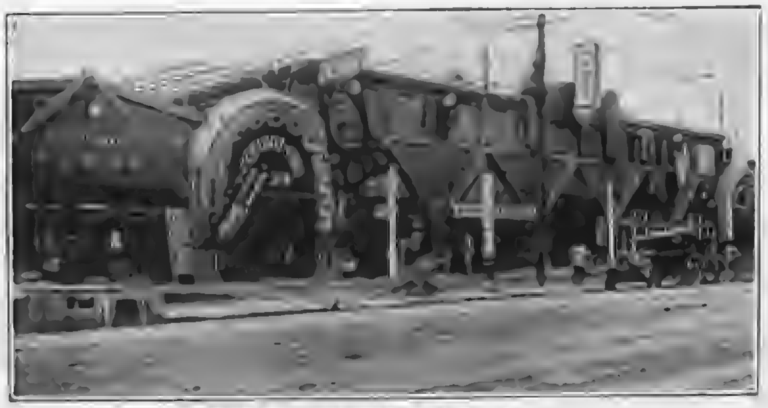
Special provision will be made as regards foundations, which will consist of a skeleton reinforced concrete raft of as heavy a



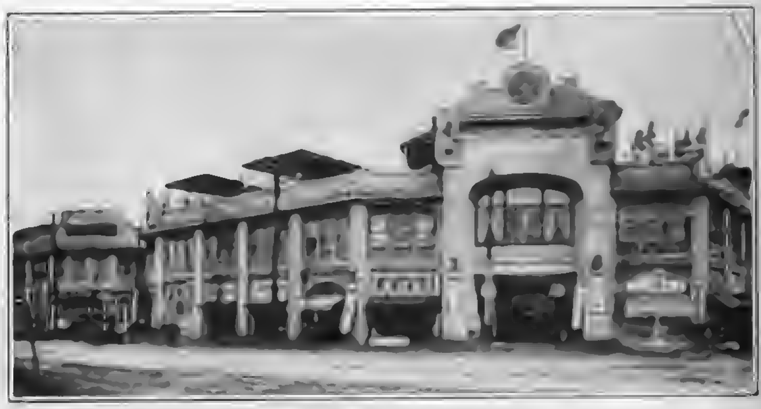
International Cement Gun, operated by an Ingersoll-Rand Air Compressor, Surfacing the Laffin Building at Yokohama



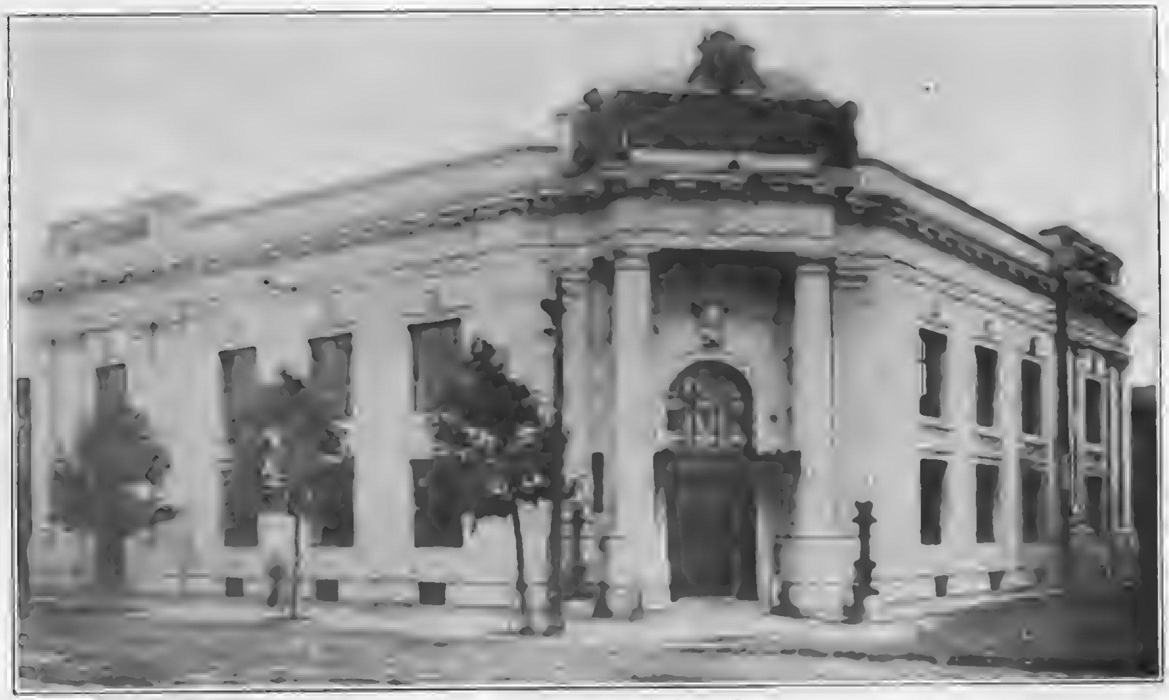
Japanese Room in the Private Residence of the Iwasakis at Tamagawa



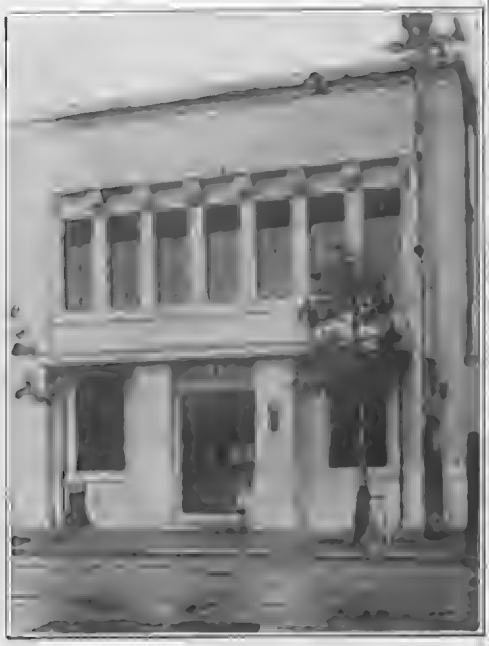
Gofuku-cho Arcade in Nihonbashi



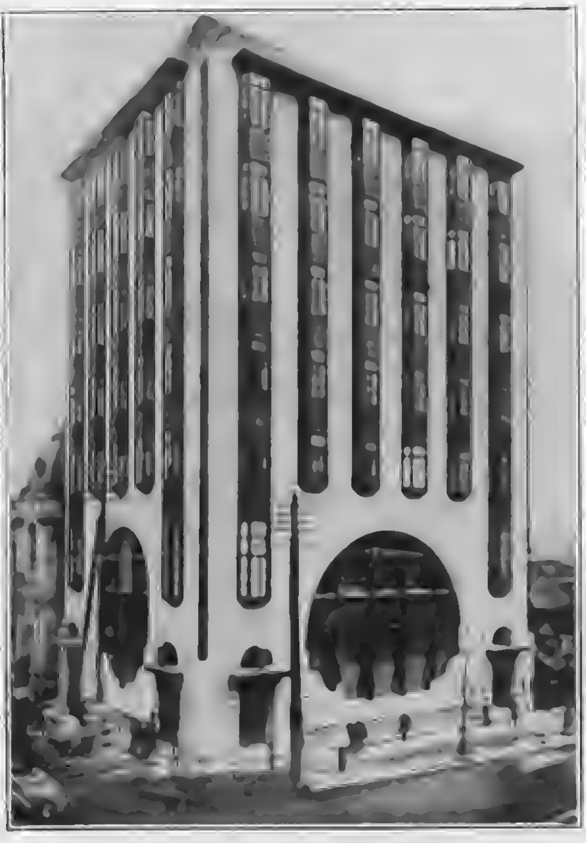
Mansei Arcade, Manseibashi



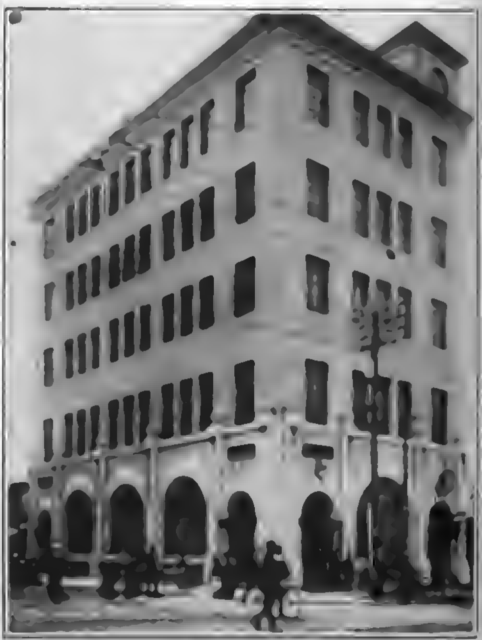
Mitsui Bank, Nihonbashi Branch



Yamaguchi Bank Branch Office

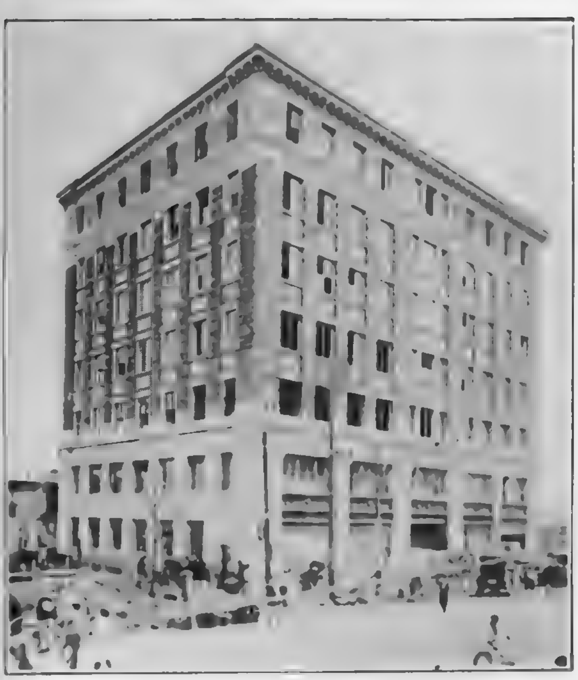


Yamaguchi Bank, Head Office, Tokyo

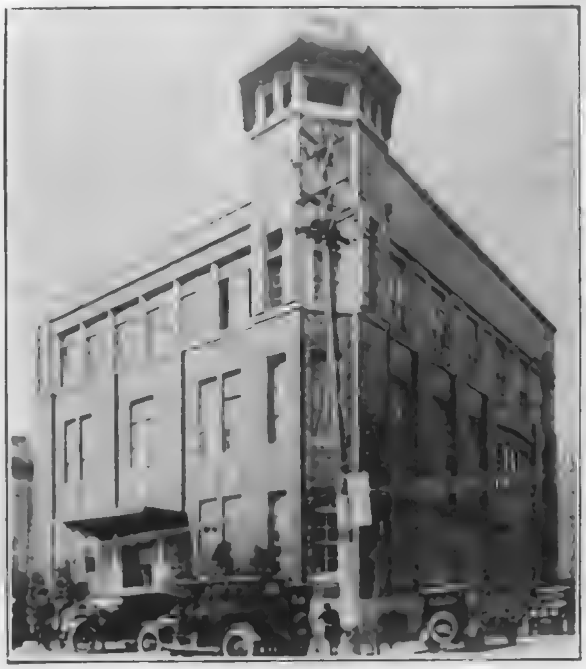


Yamaguchi Bank, Ginza Branch

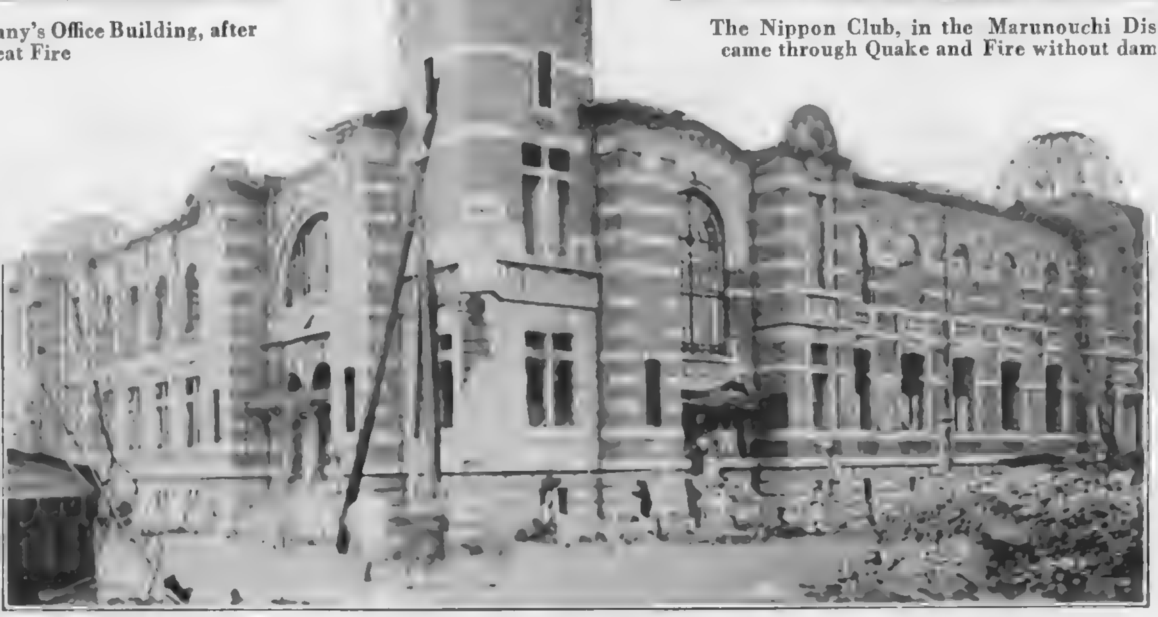
TOKYO BUILDINGS ERECTED BY TAKENAKA-KOMUTEN



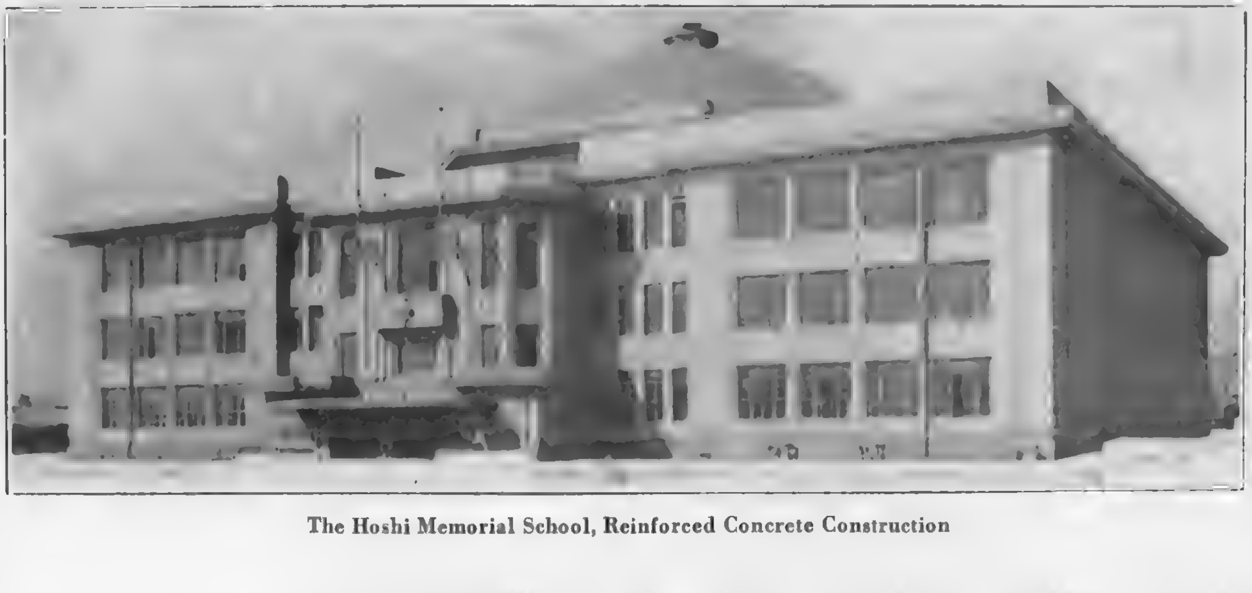
Sankyo Pharmacy Company's Office Building, after the Great Fire



The Nippon Club, in the Marunouchi District, came through Quake and Fire without damage



The Memorial Hall in Yokohama, erected by Japanese and Foreign Residents to Commemorate the Opening of the Port, a steel frame and brick building which withstood the violence of the earthquake, only to be gutted by the conflagration which followed

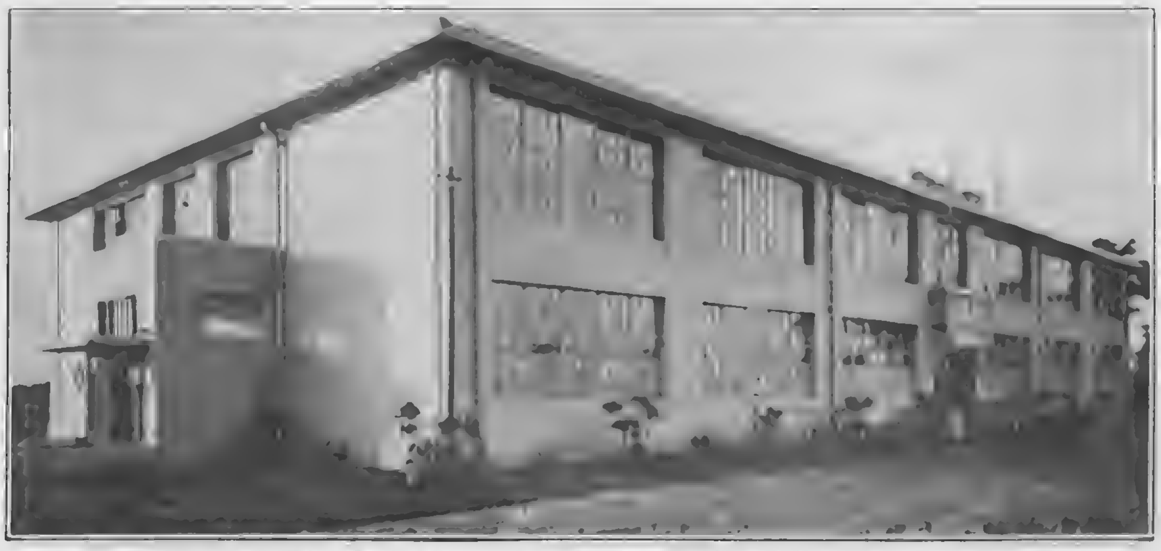


The Hoshi Memorial School, Reinforced Concrete Construction

BUILDINGS IN THE TOKYO AND YOKOHAMA

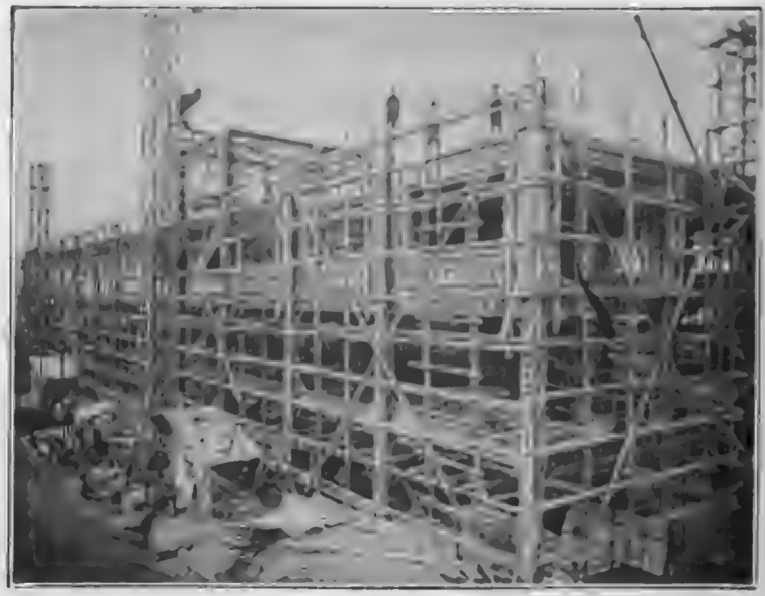
New Office Building of the Dai Ichi Ginko, newly erected in the heart of Tokyo, which was devastated by the fire. The building sustained only one small crack in the outside curtain wall as a result of the quake

New Office Building for the Tokyo Electric Light Company, a steel frame, reinforced concrete building now in course of erection



Tokyo Women's Christian College Academy Building, Two-storied Reinforced Concrete Construction

The Steel Frame and Reinforced Concrete Mill Building of the Nisshin Flour Company, erected on the Reclaimed Land at Tsurumi



New Three-storied Steel Frame and Reinforced Concrete Factory Building for the Nippon Electric Company

DISTRICTS ERECTED BY THE SHIMIZU GUMI

The Chugai Building, after the Fire

Okaya Company Building

Tokyo Branch of the Kajima Bank

Government Chemical Laboratory at Hongo

The "Asahi Shimbun" Building

Ensuiko Sugar Company's Building

Nozawaya Store at Yokohama

The "Hochi Shimbun" Building

TOKYO BUILDINGS ERECTED BY THE TAKENAKA KOMUTEN

Two Views of the Ginza

nature as is reasonable, with reinforced girders of ribbings under all main and cross walls in both directions. The foundations will be made as heavy as possible, and the skeleton raft will bear upon piles sunk into the strata beneath the building.

The buildings designed on these principles will introduce many new problems, and when the work is completed the result should present a dignified group of buildings worthy to be the residence of His Majesty's representative at the Court of the Emperor of Japan. They should be ample for the requirements of a staff which, owing to the increased importance of Far Eastern affairs, has increased largely since the Embassy was first built in 1873.

Construction work on a new Central Post-office, to be erected at a cost of about Y.6,000,000, will be undertaken before the end of the present year, according to plans of the Department of Communications. The building will be four stories high and built of ferro-concrete or reinforced steel, located in Marunouchi, the business center of the city, on the site now occupied by the temporary post-office in use since the earthquake.

Hoshi Commercial School

One of the handsome additions to the architecture of Tokyo is the Hoshi Commercial School, located in the suburb of Osaki. This building was erected by Mr. H. Hoshi, president of the Hoshi Pharmaceutical Company, operating a chemical and drug factory and a chain of drug stores throughout the empire. The main store on the Ginza before it was gutted by the great fire was a replica of the big department drug stores in the United States, fitted with ice-cream and soda-water fountains and light lunch rooms. It was one of the most popular resorts in the shopping center of the city. Nearly three years ago Mr. Hoshi called an architect, and said he wanted a school building erected capable of accommodating 3,000 students which would not only be the most up-to-date and finest in the Orient, but have an auditorium large enough to seat all the students at once.

Kokko Life Insurance Building on the Ginza, the lower part rented to the Matzuzaka Department Store. Erected by the Obayashi Gumi Co., Ltd.

The architect drew rough sketches that same night and showed them the next morning to Mr. Hoshi, who accepted them and ordered the building erected without delay. The contract for its erection was awarded to the Shimizu Gumi.

Not a single change has been made from the original rough sketches, although the finished building represents an investment of Y.2,000,000.

Impressively massive in design, the building stands like a solid rock on level ground near the Hoshi factories. Of concrete and steel construction throughout, it is not only absolutely fire-proof, but also earthquake-proof, as was shown in September of 1923, when the big earthquake did not make as much as a single crack in the walls.

The feature of the structure is the auditorium seating 3,000 persons. There is but one balcony of great depth, and the stage has an opening of 40 feet. The stage is to be equipped with machinery and fixtures to make it the equal of that of any Western theater, and will be large enough to accommodate any play or opera that may be desired to be given.

The Shimbashi Music Hall

Another handsome theater building, called the Shimbashi Embujo, has been erected since the earthquake only a few blocks distant from and in the same district as the Kabukiza. This was recently opened for performances and dances given by the geisha of the Shimbashi district in order to bring to Tokyo the celebrated cherry-blossom and other seasonal dances which have made their sisters famous in Kyoto and Osaka. Although the exterior of this theater is plain and uninteresting from an architectural standpoint, the interior is a splendid example of the adaptability of Japanese art to western structural methods. The building, of steel and concrete with brick and terra-cotta facings, is 120-ft. wide, 189-ft. long and 75-ft. high. Unfortunately no particulars concerning the building were obtainable, but its stage, almost as large as that of the Kabukiza is a revolving one fitted with all

Shimbashi Branch of the Jugo Ginko, Tokyo, a Takenaka Edifice

up-to-date theatrical mechanical innovations. The halls and lounge rooms are large and commodious, elegantly furnished and elaborately decorated.

New Yokohama Hotel

Mr. Ariyoshi, Mayor of Yokohama, is the leading spirit in a movement for the erection of a new hotel that will accommodate the many visitors to that port and serve as a social center for its permanent residents. Under his direction plans have been drawn for the erection of a million yen hotel to be erected on the Bund, and the city authorities have agreeed to furnish the funds required for construction. It is proposed to turn the completed building over to a private company, specially organized for its management, who will furnish and operate it. The city of Yokohama has Y.840,000 available in the treasury for this purpose and will lend the balance of Y.160,000 to the operating company at 6½ per cent. interest, and when the enterprise is paying eight per cent. dividends to the shareholders the company will then pay interest to the city on the whole million yen. Although plans for the building have not yet been drawn, it is proposed that it shall be of earthquake and fire-proof construction, four stories high, with one hundred guest rooms in addition to those required for social activities.

Japanese Construction Firms

The wide publicity given to the work of the Geo. A. Fuller Company and other American building constructors has created the impression that foreign technical supervision is absolutely essential in carrying out any large structural steel or engineering contract in Japan. That this idea has been permitted to take root is due entirely to the natural modesty and reticence of the Japanese, combined with a complete indifference to modern publicity and advertising methods. It is the same in building construction as in electrical and other industrial installations, where the big things done by foreign engineers receive a full measure of publicity devised by advertising experts, while the equally important engineering undertakings carried out by the Japanese are not heard of outside a very small circle of interested people in their own country. There exist in Japan several engineering and construction companies whose work stands on a par with the best American or European practice, and although in this, as in many other lines of modern engineering, the Japanese have received their instruction from the West, their progress has been so rapid that in many instances they have outdistanced their teachers, tackling undertakings on their own initiative that compel the unstinted praise and admiration of all fair-minded foreign engineers.

The names of the Okura Engineering and Contracting Company, Ltd., the Shimizu Gumi, the Obayashi Gumi and the Takenaka Kumuten are unknown outside of Japan; yet these four engineering and building contractors have done and are doing work that in any other country would fill the pages of the technical press as examples of the highest engineering skill. Everywhere throughout Japan, Korea, Formosa and Manchuria one sees engineering undertakings being carried forward under Japanese direction, which is rapidly developing the resources and industries of the empire, and at least fifty per cent. of these contracts are being executed by one or other of the above enterprising concerns.

The Okura Building Co., Ltd.

In the Okura Building Company we find a subsidiary of the Okura Gumi, one of the Big Four of Japan, ranking in the business world after the Mitsui, Mitsubishi and Yasuda interests.

At its head stands an American-trained and educated engineer, Mr. C. Kadono, who by sheer ability and worth has forged to the top and is now the vice-president and practical executive of the great Okura interests. The engineering and contracting department of the Okura Gumi is comparatively new in the field, but it has many large and important engineering works to its credit, not only in Japan, Korea and Manchuria, but in China. It is taking a most active part in the reconstruction of Tokyo, being awarded the contract for the erection of several of the bridges throughout the city as well as the greater work of taking the lead in subway construction. Many of the handsome new structures which will grace the new metropolis have been erected by this concern, the new Hall of Virtues in the Meiji Memorial Park being an architectural gem that would do credit to any capital in the world. Amongst the other structures erected by this enterprising firm in Tokyo since the earthquake is the large steel frame office building for the Oriental Development Company, now in course of construction near the Imperial Hotel, a new building for the Imperial University, the building for the Japan Beer Brewing Company, and the immense barracks or temporary wooden structures which house the activities of the Departments of Finance, Home Affairs and Communications. In Yokohama the Okura Building Company has erected a generating station for the Tokyo Electric Light Company and the factory buildings for the Kirin Beer Company, the Nisshin Flour Milling Company and the Nisshin Seiyu Company.

The Shimizu Gumi

Another eminently successful engineering and building construction concern is the Shimizu Gumi, a purely Japanese organization that came into existence about 130 years ago and has maintained its position as the leading building contractors of Japan by keeping step with modern developments and adapting them to the needs of the empire.

It would be difficult to find a city in Japan which this concern has not helped to beautify, as during its long existence it has built many important Government offices, banks, factories and private residences. Although the average foreigner looks upon the Shimizu Gumi as merely another Japanese concern that has taken up modern steel and concrete construction, its name is equally well known throughout the empire in connection with the highest examples of pure Japanese art in building design, as typified in the great banquet room of the Nijo Detached Palace at Kyoto and the Imperial mortuary shrines at Aoyama and Yoyogi.

At the time of the Meiji Restoration this company constructed the Mitsui Exchange Bank, the first modern bank building in Japan, and then the Dai-Ichi, or First Bank. The firm was reorganized in October 1915 as a limited partnership (Goshi Kaisha) with a capital of Y.3,000,000, and under the management of Mr. Kugokichi Shimizu, and afterward under that of Mr. Teikichi Shimizu, has undertaken some of the most important building contracts in Tokyo and other important cities of the empire.

The Bank of Chosen, the Katakura Raw Silk Company's building, the Okawa-Tanaka office building, the magnificent Palace Hotel (Tokyo Kaikan), together with many others which are rapidly changing the sky-line of Tokyo, have been erected by this efficient organization.

Its activities cover every branch of the building trade. Under the Tokyo Head Office the firm operates its own iron works at Shibaura, where structural steel frames for all its buildings are made; it has its own woodworking and interior trim plant at Fukagawa, a gravel pit in Kanagawa, and a quarry in Korea.

The Shimizu Gumi has branch offices at Osaka, Nagoya, Kyoto, Hakata, Keijo (Seoul) and Dairen, each equipped with its own plant and workshops. It also is represented in Yokohama, Hokkaido, Kanagawa, Hiroshima, Beppu and Harbin. Many of the handsome new buildings in Korea and Manchuria have been erected under its supervision.

At least 500 buildings are always under construction by the Shimizu firm, with 1,000 regular employees and an army of workmen on the pay-roll. The regular staff includes some of the best engineering and architectural talent in Japan. A special feature of its business is the high standard of its work, and to preserve this enviable reputation it bears absolute responsibility by never letting any of its work to sub-contractors.

The Obayashi Gumi Company, Ltd.

Another very old and successful contracting firm is the Obayashi Gumi Company, Ltd., which was organized into a limited company in 1892 with a capital of Y.2,000,000 under the presidency of Mr. Y. Obayashi. The activities of this company cover every branch of engineering and building construction. Not only do they undertake general building construction, but contract for railway and hydro-electric work, harbor and river improvements, dockyards, bridges and tunnels, and are amongst the largest labor contractors in the empire. Like the Shimizu Gumi, the Obayashi organization is self-contained, taking full responsibility for all work entrusted to them without sub-letting to other contractors. Their organization is so well equipped that their work has always been completed within contract time, being enabled to maintain this reputation by operating its own interior trim and working factories and structural steel plants. One of these is located at Chishima-machi, under the head office at Osaka, and the other at Fukagawa in Tokyo.

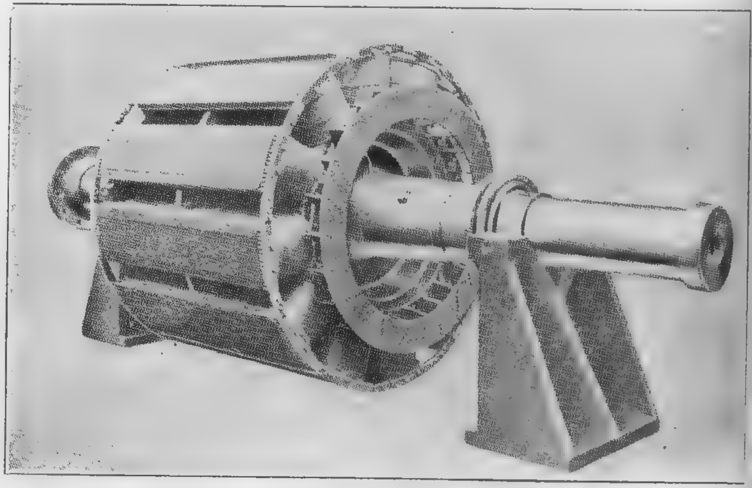
Since its organization into a limited company in 1892 the Obayashi Gumi has completed work aggregating over seven hundred million yen, in which are included more than thirty per cent. of all Government buildings. The high honor was conferred on this firm to construct the Meiji Imperial Funeral Mausoleum and that of the late Shoken Empress Dowager, as well as the main contract for the permanent Eastern Imperial Mausoleum at Momoyama. Many of the most important buildings and engineering works in Western Japan were constructed under the direction of the Osaka office of the company, while in Tokyo stands the Central Railway Station, the Industrial Bank of Japan and the Kabuki Theater as monuments to their engineering ability. These three buildings stood the upheaval without a crack or damage of any kind when many other modern structures either failed completely or developed structural weaknesses of varying degrees. A brilliant and enviable record.

Takenaka Komuten

One of the most active and successful Japanese construction firms is the enterprise conducted under the name of the Takenaka Komuten. Like many other prominent Japanese companies, the present organization is the outgrowth of a business originated centuries ago when Japanese architecture reached its highest point. The founder of the House of Takenaka was chief constructor for the great Daimyo, Nobunaga Oda, and when his chief was defeated, removed to Nagoya and originated what is known as the Osumi style of architecture. Many of the most beautiful temples and shrines of the period are the work of the forefather of the present head of the firm.

His descendant, Mr. Toemon Takenaka, was quick to see the great opportunities created by the development of his country along Western lines, and in 1899, at the commencement of the modern era, he established the Takenaka Architectural Office. Scrapping the old Japanese conventionalities in design, structure and working methods, he boldly undertook the most modern types of construction. It is difficult to say much about this very modest and enterprising concern. Mr. Takenaka believes that his work speaks for itself, and in a handsome booklet of 120 pages presents the illustrations of the many modern buildings erected by the firm in various parts of Japan. The list of these buildings would fill a page of the magazine. They cover a wide range, embracing banks, Government buildings office buildings, cotton mills, stock exchanges, department stores, schools, college buildings, Y.M.C.A. edifices, observatories, hospitals, temples shrines, palaces, private residences, warehouses, newspaper offices, hotels, etc.

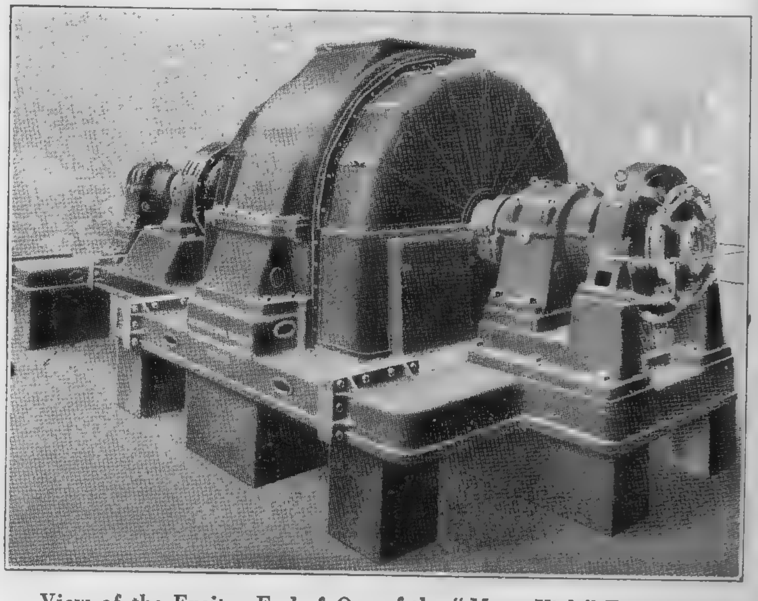
With this article we present two pages of illustrations of new buildings erected in Tokyo by the Takenaka Komuten, which show that it is keeping abreast of the times with the most modern and approved construction methods. The head office of the firm is in Osaka, where they have erected most of the important modern buildings which grace this city.



Finished Rotor of "Metro-Vick" Frequency Changer.

Large Frequency Changer for Japan

THE very large hydro-electric development which is taking place in Central Japan, chiefly as the result of the activities of the Daido Electric Power Co., Ltd., has resulted in the linking together of many hitherto isolated systems. The Momoyama Power Station is one of a series of Hydro-Electric Stations which are built or building along the course of the Kiso river. It is almost mid-way between two large centers of distribution, *i.e.*, Tokyo, where the periodicity is 50, and Osaka, where the American standard of 60 periods has been adopted. It is here that the Frequency Changer, built by the Metropolitan-Vickers Electrical



View of the Exciter End of One of the "Metro-Vick" Frequency Changers for the Momoyama Power Plant.

Co., Ltd., is to be installed. This machine weighs 208 tons, and its overall length is 50-ft. 6-in. The set consists of two machines coupled together with a starting motor between them and an exciter for each machine on the outer end of each shaft. The individual machines are designed so that they will operate when uncoupled as synchronous condensers, so that at any time in the future if it is not desired to transfer load from the 50-period to the 60-period side of the system, or *vice versa*, and will be connected up for 11,000 volts star connection.

The output as a frequency changer is at 6,600-6,600 delta connected, 50-60 periods, 600 r.p.m., and is equal to 16,000 kva. at 0.94 power factor, that is 15,000 kw., with 25 per cent. overload for two hours without injury. As a separate machine running as a synchronous condenser, the ten-pole machine gives 15,000 kva. leading and lagging at 50 periods, 600 r.p.m. and 15,000 kva. leading and 12,500 kva. lagging at 60 periods, 720 r.p.m. Under the same conditions the 12-pole machine gives 15,000 kva. leading and lagging at 60 periods, 600 r.p.m.

When used as a frequency changer the starting motor is used for running the set up to synchronous speed and the resistance steps operated by contactor gear, but when the unit is split into two machines for use as synchronous condensers, each machine will be tap-started by means of an auto-transformer. Damper windings are provided on the machines for this purpose.

In order to facilitate starting both as a frequency changer and when the set is split, a special high-pressure oiling system is provided, and it was found that by this means the starting torque could be reduced to approximately 1½ per cent. of full load for each machine, the starting kva. being about 12 per cent. respectively.

It will therefore be possible to guarantee in future a starting kva. of approximately 15 per cent. of full kva. if this point is of sufficient importance.

In addition to the high-pressure lubricating system for starting, an ordinary lubrication system for running is provided.

The machines passed all tests successfully, and equivalent heat runs were made to ensure that temperature guarantees, etc., were met.

The Brains Behind the "Daido"

Momosuke Fukuzawa

THE recent successful issue on the New York market of a further $13,500,000 gold loan through Dillon, Read & Company for the Great Consolidated Electric Power Company, Ltd. ("Daido"), of Japan, has attracted considerable attention to the personality of the man whose enterprise has created one of the largest super-power companies in the world. The issue was a 6½ per cent. offered at 86 and interest to yield over 7¾ per cent.

Sinking fund provision calls for retirement of $300,000 per annum for the first ten years and $700,000 per annum thereafter at a price not exceeding 100 and interest either by purchase or by call by lot.

Mr. Momosuke Fukuzawa, the Electrical Wizard of Japan

The bonds are a direct obligation of the company and are secured by a closed first mortgage lien under the laws of Japan on properties representing a cost, less depreciation as of February 28, of $33,234,000.

The bonds are further secured by closed mortgage lien on additional properties representing a cost of $37,063,000, subject only to the lien of the mortgage securing the $14,500,000 series "A" bonds.

Net income before interest and depreciation for the twelve months ended May 31 amounted to $5,241,398, or about two and three-quarter times annual interest requirements on total mortgage bonds and about twice the annual interest charges on both mortgage and debenture bonds to be outstanding on completion of the new financing.

This loan brings the dream of Momosuke Fukuzawa, of a great super-power system covering the entire main island of Japan, one step nearer fulfilment. This great Japanese industrialist, who has made his own way in the world, has now borrowed something like $30,000,000 from American investors in one year.

Momosuke Fukuzawa is the son of Yukichi Fukuzawa, educator and philosopher, who seventy-five years ago was one of the first Japanese to visit the United States to learn the language and study American customs. He thought that in individuality he had discovered the secret of American success in business. "Strike out for yourselves," he advised his children. "Do not wait for somebody to push you along and do not depend on other people. In individuality lies success."

Momosuke Fukuzawa heeded his father's advice. Upon graduation from Keio University, founded by Yukichi Fukuzawa, he sailed for the United States and entered a private school near Boston. He was graduated from that school a young man in his twenties, and found employment in the freight offices of the Pennsylvania Railroad, always fending for himself. His father held rigidly to his policy of making the boys stand on their own feet.

When the young Japanese student believed he had a grasp of American railroading he returned to Japan to work out some of his ideas for giving the island proper transportation. When the Japanese Government took over the Japanese railroads Momosuke Fukuzawa entered the electrical field. He believed in the American system of unification.

A great opportunity, he thought, existed to form a large generating and transmission company to supply power to the various companies owning distributing systems in the principal power-consuming districts of Japan. The "Daido," or Great Consolidated Electric Power Company, Ltd., was organized as the first step in an ambitious plan to merge many other properties. Then Momosuke Fukuzawa started to build power plants, and he still is building. He retained American consulting engineers, and he saw to it that his plants were equipped with the most modern machinery from the United States.

At present the Company owns nine hydro-electric power plants, having a total capacity of 169,540 kilowatts, and four steam generating plants of a combined capacity of 100,500. It is primarily a wholesaler of power, and as such is the second largest manufacturer in Japan. The total power output is exceeded only by the Tokyo Electric Light Company and its subsidiaries.

In less than three years the Daido has trebled its generating capacity, and present plans call for a similar increase in the next three years. Momosuke Fukuzawa is in his late fifties, but he still is planning far into the future. He is working on plans in connection with the electrification of Japanese railroads.

Momosuke Fukuzawa's interests are widespread, and he is a powerful figure in all of the important industries in Japan. He is a director of thirty-eight corporations. He is an engineer of recognized distinction and an author of many books on science and finance. He wrote a financial history of the United States. At one time he was a member of the Japanese parliament.

Continuing the educational work of his father, he has written a book of advice for boys under the title, "Let Me Tell You Frankly." He is well known in railroad and electrical circles in America. At Union College, Schenectady, on June 9, 1924, Momosuke Fukuzawa received the honorary degree of doctor of science. He is progressive in his ideas on sport and is one of the leaders of the movement in Japan to encourage women to play tennis.

MITSUI
Where Business is Humanity

A Family Corporation Which Personifies the Traditions and Spirit of Japan. Enduring through the Centuries While Other World-wide Trading Companies have been born, lived their lives, and faded into oblivion.

By George Bronson Rea

TO single out any particular group, firm or individual as deserving of special praise or merit for their financial contributions to the fund for relieving the earthquake sufferers would be eminently unfair. When the call for help came, the response was immediate from rich and poor alike, all giving generously according to their means. It is unsatisfactory to draw conclusions from dry statistics, yet the *Japan Year Book* states that the Emperor donated Y.10,000,000 to the Emergency Relief Fund, while another Y.30,760,000 was disbursed from the national treasury. Excluding the Imperial donation, the total relief funds from all sources was Y.59,013,395, of which Y.21,614,301 came from abroad.

It is not surprising that the great Mitsui family out of their abundant wealth should contribute Y.5,000,000 to the fund, or that the amount, together with the donations of other wealthy individuals and corporations, should be given due publicity. Such contributions were measured largely by the munificence of the Imperial family, which no private individual, no matter how great his wealth, would attempt to exceed. That contribution was spontaneous, the logical and proper thing to do. From the Emperor down they gave according to their wealth, and then proceeded in their own quiet ways to supplement this by further contributions for special charities and relief work carried out under their own supervision.

How much more was spent by the Mitsuis in the cause of humanity for erecting barracks, distributing food, clothing and bedding, in maintaining hospitals, facilitating transport of food supplies on their steamers and lighters, extending free storage in their warhouses and using their organization for the common welfare, is a totally different matter, one that will never be made public. This secret is preserved in the private archives of the Mitsui family, a memorial to the past and a reminder to future Mitsuis that the present generation has faithfully lived up to the cardinal precept of the family, "BUSINESS IS HUMANITY."

Baron Hachiroemon Mitsui, Head of the Eleven Mitsui Families whose Centuries-old Code of Business Honor has carried them to the highest pinnacle of commercial prosperity

The Mitsuis, more than any other present-day organization in Japan, are typical of the nation. For the Mitsuis *are* Japan, the personification of its traditions, its virtues, its institutions, its chivalry and its commerce. It is the greatest family corporation the world has ever known. There are families in Japan, descendants of shoguns, daimyos and samurai, who have blazed their name across the pages of history as statesmen and fighting men, but there are few who combine all that is best in the national character with all that is best in trade and finance, an occupation for many centuries looked down upon as unworthy of the fighting man. The Rothschilds are perhaps the most striking example of family unity in high finance that the western world is familiar with, but the family is international, broken up for business purposes, typical of its race and its traditions. The Astors, the Vanderbilts, and the Goulds conform to the normal type of American millionaire families, where the original fortune has been divided and scattered through international marriages. We have to come to Japan to find a family corporation that stretches back in an unbroken line to the medieval ages with a definite program and fixed policy directing its activities for the past three hundred years.

The Mitsui pedigree goes back to the sixth century with a well-established line from that period to the 12th century, when Takahisa, the daimyo of the Sasaki clan and overlord of Omi, was adopted into the family, bringing with him the coat of arms represented by four black squares with white centers, since then the recognized escutcheon of the Mitsui family. From this point the history of the Mitsuis is carried forward to the present time through existant archives without a break. The successor of Takahisa was Takayasu-Mitsui, the lord of Echigo, whose son, Sokubei Mitsui, initiated the business which has since grown to such vast proportions. His son, Takatoshi Mitsui, started business in Kyoto and then established a drapery shop in Yedo, one of the pioneer merchants to open business in the new capital of the shogun.

In Yedo was laid the foundation of the great Mitsui fortune by one of the younger brothers of Takatoshi, named Hachirobei Mitsui.

This young man introduced the system of double entry book-keeping and cash retailing, since accepted in all parts of the world as the safest method in merchandizing, antedating the bargain sales of the modern American department stores by three centuries. The business methods which have elevated the Woolworths, the Wannamakers, the Marshall Fields and the Selfridges to the proud position of merchant princes was introduced in Japan by a sixteenth century Mitsui. Hachirobei Mitsui also worked out and applied the principles upon which modern world banking is conducted, organizing the collection and remittance of money throughout the country by bills of exchange at a time when these paper transactions were unheard of in Japan. This was the beginning of the Mitsui banking business, resulting in Hachirobei's appointment to the position of purchasing agent to the shogun in 1687, later on in 1691 to be entrusted with all the remittances of the Government, equivalent to the duties of a modern state treasurer and paymaster-general. From this time forward the business of the Mitsuis has been closely identified with the fortunes of the Government of Japan.

Dr. Takuma Dan, Director-General of the Combined World-wide Mitsui Interests. An engineer-executive and creator of wealth who has risen from the ranks to the head of the greatest organization in Japan. One of the world's foremost captains of industry

The drapery store in Yedo prospered beyond measure, overflowing the capacity of the original shop and necessitating a larger and more central location. The historic site at Suruga-cho was then acquired, and from that date has remained the business headquarters of the family. An illustration of the original Mitsui department store in old Yedo, painted by Hiroshige, the greatest Japanese artist of his time, is reproduced with this article, together with the headquarters building destroyed during the fire and the magnificent new structure that will replace it. The buildings alone typify the growth of the Mitsui influence in Japan. The banking business initiated by Hachirobei Mitsui way back in the sixteenth century has developed into the present Mitsui Bank, one of the strongest financial institutions in Japan and rapidly extending its sphere of influence in foreign countries. After the death of Hachirobei, other Mitsuis were called upon by succeeding shoguns to supervise their finances, and when the great issue came before the nation for the restoration of the Mikado it was the Mitsuis who principally financed the imperial armies in putting down rebellion and restoring power to the actual sovereign.

After the Meiji Restoration, the Mitsuis acted as treasurers for the Imperial Government and materially assisted in the financial and political solidification of the new régime, a fact that will help in part to explain the present prominent position of the family in the councils of the nation. The history of the Mitsuis since the Restoration is the economic history of Japan. As far back as 1707 they became interested in foreign commerce by appointing a resident representative at Nagasaki to conduct business with the Dutch traders. When the country was opened up to foreign trade as a result of the visit of Commodore Perry in 1853, the Mitsuis were one of the first to establish foreign branches, though it was not until 1876 that the Mitsui Bussan Kaisha (known in Europe and America as Mitsui & Company) was organized for general trading purposes, with special reference to foreign trade. This company now has 21 branches in the principal cities of the empire as well as 36 offices in foreign countries, the largest and most important trading concern in the world.

In the same year the old Mitsui Ryogae Ten (exchange shop) was transformed into the Mitsui Bank, the first and by far the largest private banking establishment in Japan. As a result of the acquisition of the famous coal mines from the Government in 1889, the Mitsui Mining Company was established to take over the mining activities, conducted up to that time by the Mitsui Bussan Kaisha and the Mitsui Bank. The Mitsui organization grew and prospered, keeping pace with the development of the empire, and carrying the flag of the Rising Sun to all countries of the world. The abnormal growth of the Mitsui business during these years made it necessary to make radical changes in the system and constitution of their undertakings, and after long and thorough investigation of European and American methods a complete reorganization was effected in October 1909.

For centuries the Mitsui business had been conducted as a purely family concern composed of the eleven constituent families belonging to the house and known by the name of its ranking male representative. At the head of the entire House stands Baron Hachiroemon Mitsui, followed by the families headed by Motonosuke Mitsui, Genyomon Mitsui, Takayasu Mitsui, Hachirojio Mitsui, Saburosuke Mitsui, Fukotoro Mitsui, Morinosuke Mitsui, Takenosuke Mitsui, Yonosuke Mitsui and Tokoyomon Mitsui. Through all the centuries these eleven families have worked in complete harmony, co-ordinating their fortunes and activities for the common welfare.

Each of these family chiefs has been trained for his career, with very definite duties to perform. There is always room at the top of a Mitsui concern for able excutives, and in the roster of those who have managed their various enterprises and retired, or who have left the firm to start business for themselves, are the names of many of the most successful business men in Japan. At the same time, the chiefs of the eleven Mitsui families are not living in ease and luxury while others are directing their business. Baron Hachiroemon Mitsui, the head of the house, is President of the Mitsui Gomei Kaisha, the holding company for all the Mitsui enterprises and the several subsidiaries intimately related to them. Baron Takayasu Mitsui is the

Kikusaburo Fukui, Managing Director of the Mitsui Gomei Kaisha

Tokutaro Sakai, Director of the Mitsui Gomei Kaisha

Nagabumi Ariga, Managing Director of the Mitsui Gomei Kaisha

president of the Mitsui Bank, Genyomon Mitsui presides over the Mitsui Bussan Kaisha, Motonosuke Mitsui is president of the Mitsui Mining Company, Yonosuke Mitsui presides over the Toshin Soko, Tokoyomon Mitsui heads the Oji Paper Company, and Morinosuke Mitsui the Shibaura Engineering Works.

Many of the foremost big business men of Japan have been connected with the Mitsui and their enterprises in some form or other. The present group of directors are all tried and trusted executives who by loyalty, integrity, efficiency and all-round worth during a lifetime of allegiance to the Mitsui interests have reached the top of the ladder. At the head of this group stands Dr. Takuma Dan, who by sheer ability, creative force and executive fitness has risen from the bottom to the most commanding position in the commerical life of Japan, one of the world's really great captains of industry. Takuma Dan is an engineer, with the degree of Doctor, one of the men who have raised modern Japan to her present proud position as an industrial nation, a fitting director-general for a family whose wealth has been so largely responsible for this transformation. Dr. Dan, born in 1858, is a native of Fukuoka, a mining town in Kyushu. In 1871 he accompanied Lord Kuroda, of the Fukuoka Clan, to America, remaining in Boston to be educated as a mining engineer. He graduated with honors from the Massachusetts Institute of Technology, and after his return to Japan spent three years as lecturer at the Osaka Technical College and in 1881 was made engineer of the great Miike coal mine, then owned and operated by the Government. Here Takuma Dan laid the foundation of his subsequent career, specializing in and making himself the most competent authority on the mining possibilities of the Miike region. When the Mitsui purchased the Miike properties from the Government in 1889, Dr. Dan entered their employ as chief engineer. We find the young engineer gradually forcing himself up to positions of importance in the Mitsui Mining Company, then into the auditorship and directorate, and from there to the supreme direction of the properties. From a simple coal mine the Miike properties have been developed into one of the greatest industrial and engineering centers in the Far East. The mines themselves were enlarged, their output increased, a magnificent harbor for handling coal and facilitating exports, a smelter refinery, an iron works and dye works, with their subsidiary bye-product plants, have been added to the original mining installation. Wealth was created from waste. This was the work of Takuma Dan. He took the Mitsui fortune and created for it a new foundation. From the small beginning in 1892 the Mitsui Mining Department has evolved into the present Mitsui Mining Company, Ltd., with its capital of Y.100,000,000 and an annual coal output equal to one-quarter of the total mined in the empire. The creative force behind this development was rewarded by the Mitsui Family Council by making him director-general of all its vast enterprises. Dr. Takuma Dan, the engineer educated at the "Boston Tech," had reached the top, a fitting tribute to his untiring energy and executive ability. His usefulness will continue as long as he lives, and when the day arrives to lay down the cares of the greatest business organization in the world of to-day he, like his brilliant predecessor, Baron Takashi Masuda, will retire behind the scenes to become Adviser to the Mitsui Family. Dr. Dan personifies the basic precept of the Mitsui code: "Business is Humanity." Behind a dynamic personality and keen business exterior is one of the most humam and lovable characters that it has been our good fortune to meet in any country of the world. That Takuma Dan is accepted by the other Japanese captains of big business as their leader is not altogether due to his exalted position. His leadership in the world of Japanese finance, commerce and industry has been attained and held by those high qualities of character and disposition which endear men to their associates.

Yunosuke Yasukawa, Senior Managing Director of the Mitsui Bussan Kaisha, the Greatest Trading Concern in the World

It is difficult for an outsider to gather accurate information about the vast Mitsui holdings. They are so diversified and so interwoven into the very fabric of Japan's economic life that it is impossible even for Japanese to say when the Mitsui begins and ends. There are many captains of big business in America and Europe who have achieved world fame in some particular industry, but we know of none whose executive genius is called upon to direct such a varied assortment of big enterprises as the director-general of the Mitsui Gomei Kaisha. In addition to his duties as head of the Mitsui corporation, he presides over the Hokkaido Mining and Steamship Company, operating mines and iron works in Hokkaido and a line of steamships. This company is capitalized at Y.70,000,000. He is also managing director of the Japan Steel Works, the second largest in Japan, an Anglo-Japanese enterprise in Muroran, Hokkaido, where the big guns for the Japanese army and navy are manufactured. This corporation is capitalized at Y.30,000,000, all paid up. The Mitsui Mining Company with its many ramifications and manufacturing plants is capitalized at Y.100,000,000; the Mitsui Bank at the same figure; the Mitsui Bussan Kaisha is also a Y.100,000,000 corporation; the Mitsui Trust starts in business with Y.30,000,000; the Toshin Soko has a capital of Y.15,000,000; the Oji Paper Mill Company, with its manufacturing plants, forests and railways, is capitalized at Y.50,000,000; the Shibaura Engineering Works at Y.20,000,000. The Mitsui Bussan Kaisha operates a dock and shipbuilding yard near Okayama, a gigantic undertaking launched in the spring of 1918 in order to rival the Kawasaki and Mitsubishi yards. The post-war slump, the Washington Conference and the practical giving away of U.S. Shipping Board vessels for the Pacific service (the greatest shipping subsidy ever extended by any Government for the furtherance of its trade), have all united to kill the Japanese shipbuilding industry and cripple their trans-Pacific shipping lines. The great Mitsui dock and shipbuilding yard, like that of Asano's at Tsurumi, and many others erected in the boom days of the war, is now a dubious asset. The Mitsui, however, are operating their yard, and some months ago turned out the first motor-driven steamships made in Japan. Mitsui capital is found in many textile companies. In Shanghai the Mitsuis operate their own cotton mills. Near Osaka the Mitsui Bussan Kaisha operates one of the largest celluloid plants in Japan under the name of the Sakai Celluloid Company. The Chinese Government is a heavy debtor to the Mitsui for arms and other supplies. The Bussan Kaisha holds an exclusive radio concession from the Chinese Government and has erected a five-million-yen radio plant near Peking which is now in communication with the other high-powered radio stations of Europe and America. The engineering department of the trading company holds many important agencies of American manufacturers not only in Japan, but for China. In fact, this Japanese firm is the best representative that America has in the Orient. Its volume of sales of American products surpasses that of all other American firms in China and Japan. Its sales of American locomotives, rolling stock, rails, bridges and railway supplies and machinery have done for Americans in China what they have never been able to do for themselves.

The Mitsuis are large shareholders in the South Manchuria Railway, whose properties are now valued at over a billion and a half yen. Since the Japanese have controlled the line they have expended by this time at least $100,000,000 gold for American materials. They have created in Asia an up-to-date American railway, equipped throughout in almost every detail with the most approved American appliances. A large proportion of this great volume of business has been placed in America through the New York office of the Mitsui Bussan Kaisha. Invariably a Mitsui man will be found on the board of directors of the South Manchuria Railway Company. The Mitsuis created the soyo bean industry and are the largest operators in beans and bean oil, the staple products of Manchuria, with their own oil mill and oil storage tanks at Dairen. Throughout all the ports of the Far East the Mitsuis own their own wharves, godowns and coal storage yards, doing an enormous business in bunker coal. The Mitsuis built and equipped with American material the Kiukiang-Nanchang railway, and if the Chinese ever repay their obligations and extend the line southwards and out to the sea at Foochow or Swatow, it will be another American-equipped line in the heart of China built with Japanese money.

The companies above enumerated have an aggregate capitalization of over Y.500,000,000. These figures are public property. It is not far from the truth to state that the Mitsui properties and investments total at least a billion yen, an enormous capital for Eastern Asia. The management and administration of these vast holdings calls for men of exceptional business ability, and places Dr. Takuma Dan well up amongst the very foremost of the world's great executives.

Dr. Tamaki Makita, Senior Managing Director of the Mitsui Mining Company

It is only necessary to pick up the *Japan Year Book* and scan the section devoted to "Who's Who in Japan" to gather an idea of the careers of the men now directing the various Mitsui companies and those who have retired to enjoy a well-earned rest or who have left the firm to start business on their own account. After Dr. Dan comes his immediate associates, the managing directors of the Mitsui Gomei Kaisha, the holding company for the family fortune. Here we find Nagabumi Ariga, brother to the man who for many years has been adviser to the Chinese Government. Mr. Ariga is a young man of sixty, who holds that his work is just beginning, a specialist in commercial law, the legal brains of the Mitsui organization. Kikisaboru Fukui, another young man of fifty-nine, has seen forty-two years of service with the Mitsui and is still going strong. Mr. Fukui has come up the ladder through the management of several of the important Asiatic branches of the Mitsui Bussan Kaisha, and its New York office, to the head of the trading company, and from there to the holding company. His vast commercial experience makes him one of the most important members of the inner council. Another director of the holding company is Mr. T. Sakai, a Harvard graduate educated for the ministry, who made a name for himself in the Foreign Office before the Mitsui council invited him to join their organization. Mr. Sakai is another enthusiastic worker nearing his sixties, and, as mentioned elsewhere, it was due to his personality, diplomacy, good nature and exact knowledge of the American character which made the work of the American Relief Commission such a wonderful success after the earthquake. The other member on the board of the holding company is Masataro Oshima, elevated to this position after 33 years of service with the Mitsui Bank. He is the financial expert of the organization.

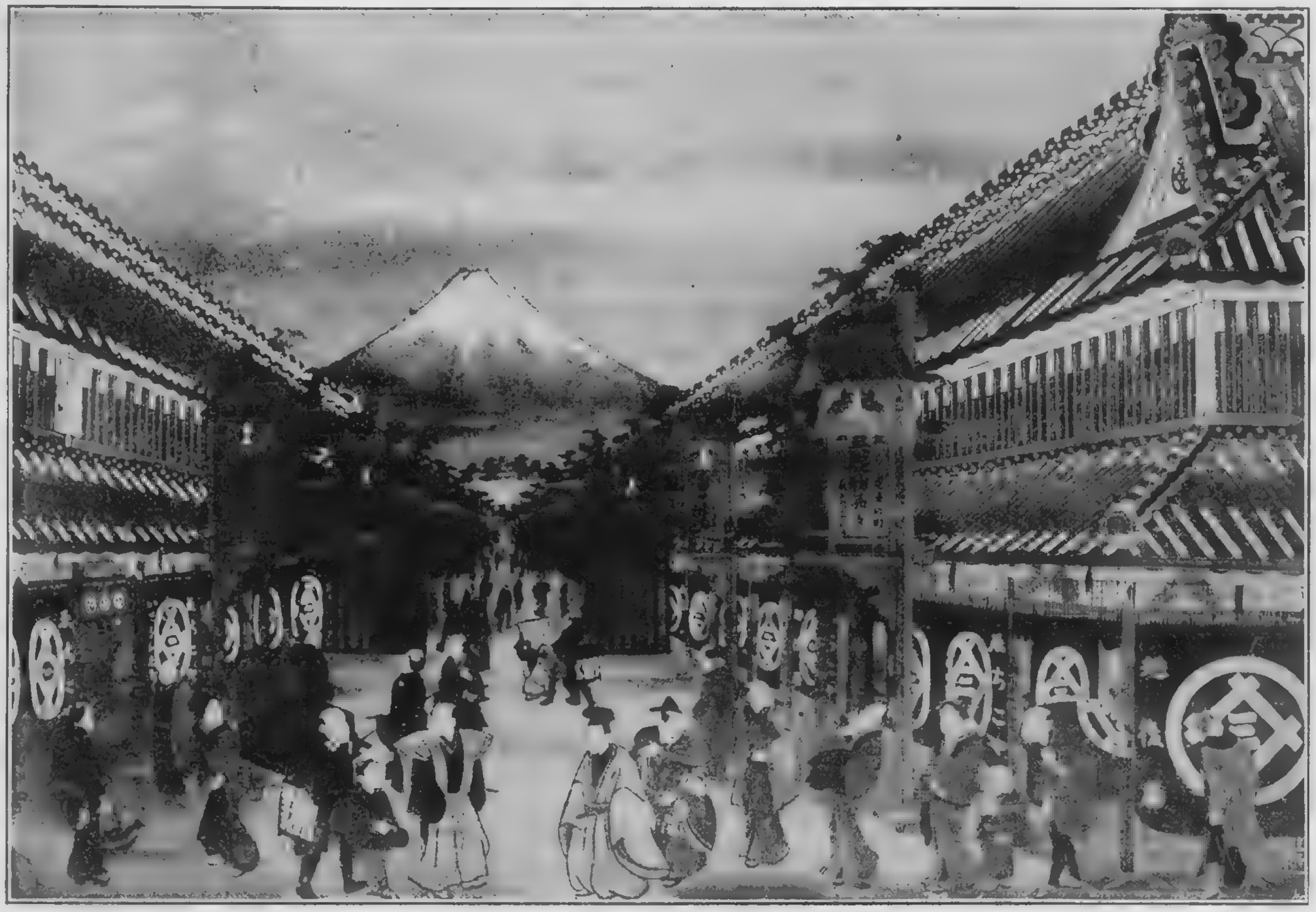
The senior managing director of the Mitsui Bussan Kaisha is Yonosuke Yasukawa, born in 1870, and entering the Mitsui organization when he was 9 years of age. After serving as manager of many of its branches he was elevated to the directorate in 1917 and is now the active head of the trading company. Tamaki Makita, a doctor of engineering, is the senior managing director of the Mitsui Mining Company. He entered the Mitsui employ as a mining expert and has forged his way to the place vacated by Dr. Dan. Umekichi Yoneyama, the president of the newly-established Mitsui Trust Company, is a gifted financier who studied in America and afterwards entered the Mitsui Bank. Subsequently, he made a tour of America and Europe investigating banking methods, and when the Mitsui Bank was organized as a limited company was chosen as its managing director, a post which he still holds in connection with his present duties as head of the trust company.

Seihin Ikeda, managing director of the Mitsui Bank, is held by his financial associates in Japan and America as one of the brainiest international financiers of the day. He was born in 1868, and studied at Keio and Harvard. Entering the Mitsui banking department he rose to be manager of its important Osaka branch, and then toured America and Europe to study and report on modern banking methods for his superiors. It was on the strength of his report that the Mitsui family changed the organization of the bank from a limited partnership into a joint stock corporation in 1909.

The managing head of the Oji Paper Mill Company, an important Mitsui subsidiary, is Ginjiro Fujiwara, who started his commercial career in the Mitsui Bank and was shifted to the Mitsui Bussan Kaisha, where he subsequently became manager of the Shanghai and Formosan offices, establishing a record for business efficiency and knowledge of Far Eastern markets that his elevation to the management of the Oji Paper Mills came as a matter of course. At the head of the Shibaura Engineering Works, whose new plant at Tsumuri will revolutionize manufacturing methods in Japan, stands Kenzo Iwahara, a former managing director of the Mitsui Bussan Kaisha, who rose to the top through his remarkable trading ability, having managed the London, Osaka and Kobe branches and established the New York office of the company in 1896. After retiring from the trading company he was brought back into active service to preside over the great electrical and engineering works that has already contributed so largely to establish a high reputation for Japanese-made machinery.

Mr. George Marvin, writing in *Asia*, was enabled through the courtesy of the Mitsui family to give to the world the code which governs the operations of this "human corporation."

The distinguishing spirit of the House of Mitsui is specifically defined in these precepts from the family code as laid down in the



The Original Mitsui Store in Old Yedo, situated on the Historic Site at Suruga-cho in Nihonbashi, which has since been the Business Headquarters of the Family. (From "Asia.")

eighteenth century by Sojika Koji (Hachirobei II.), one of the leaders in the development of the family :

1.—The members of the House should deal with one another in close friendship and with kindness. Beware that contentions among the kin do not in the end ruin the entire House.

2.—Do not needlessly increase the number of families of the House. Everything has its limits. Know that over-expansion, which you may covet, will beget confusion and trouble.

3.—Thrift enriches the house, while luxury ruins a man. Practise the former but avoid the latter. Thus lay a lasting foundation for the prosperity and perpetuation of our House.

4.—In making marriage, incurring debts or underwriting others' debts, act always according to the advice of the Council of the Family.

5.—Set aside a certain part of the annual income and divide it among the members of the House according to their rank. Give also to those who marry into outside families.

The Beautiful Mitsui Head Office Building at Suruga-cho that was Gutted by the Conflagration which followed the Great Earthquake

6.—The life-work of a man lasts as long as he lives. Therefore, do not, without reason, seek the luxury and ease of retirement.

7.—Cause to be sent for auditing to the main office the financial reports from all branch houses ; organize your finances and prevent disintegration.

8.—The essential of a business enterprise is to employ men of great abilities and take advantage of their special talents. Replace those who are aged and decrepit with young men of promise.

9.—Unless one concentrates, one fails. Our House has its own enterprises, which are ample to provide for any man's life. Never touch another business.

10.—He who does not know, cannot lead. Make your sons begin with the mean tasks of apprentice, and, when they have gradually learned the secrets of the business, let them take a post in the branch houses to practise their knowledge.

11.—Sound judgment is essential in all things, especially in business enterprises. Know that a small sacrifice to-day is preferable to a great loss to-morrow.

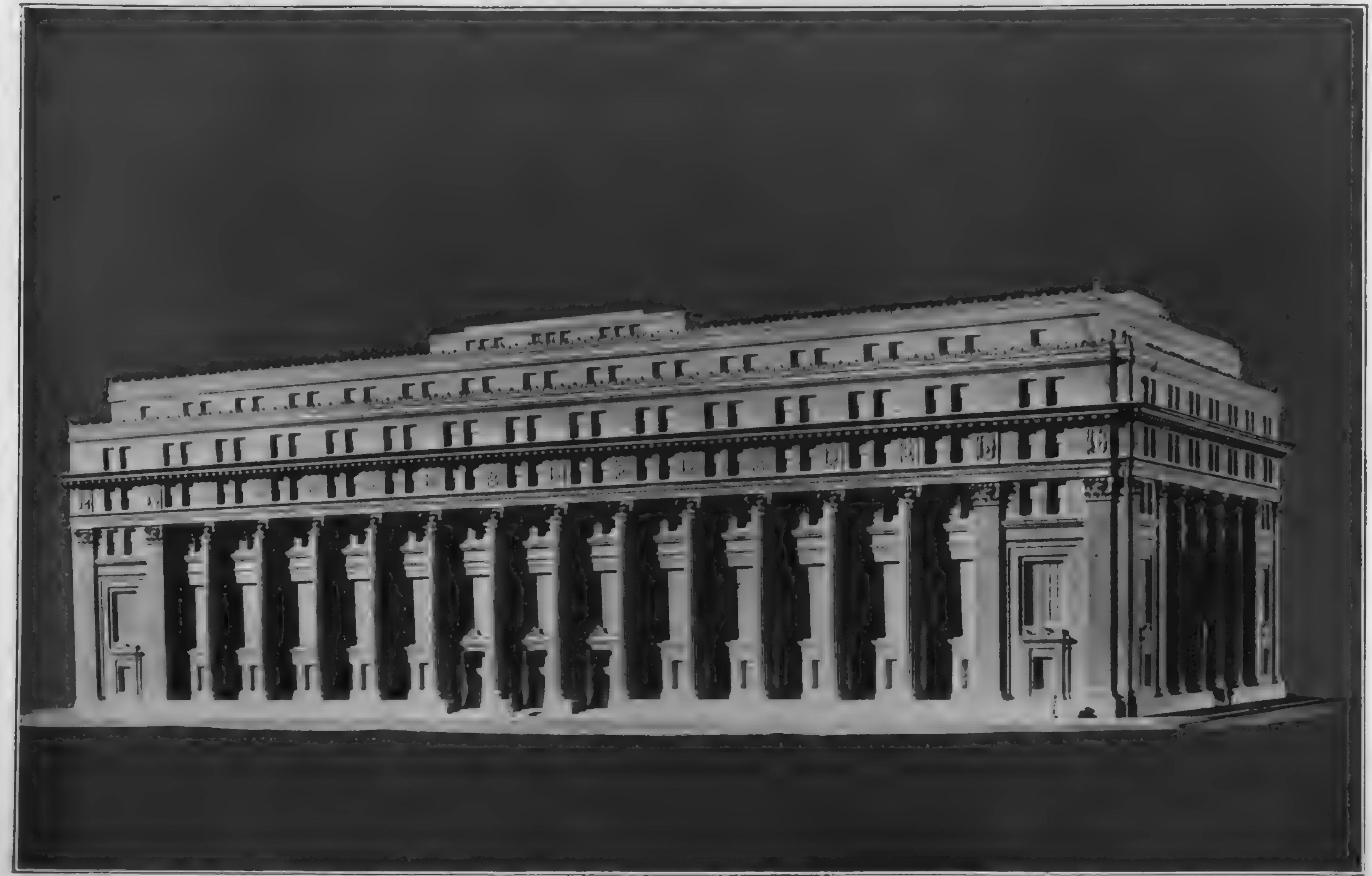
12.—The members of the House should practise mutual caution and counsel lest they should blunder. If there be among you any evil-doer, deal with him accordingly at the Council of the family.

13.—You who have been born in the land of gods, worship your gods, revere your lord, love your country, and do your duties as citizens.

Following these precepts to the letter, the Mitsuis have endured and prospered where other great organizations have lived out their usefulness and faded into oblivion. The sixth precept compels attention. A few months ago an American sat at tiffin with Dr. Dan and his associate directors in one of the private dining-rooms of the Imperial Hotel in Tokyo, and in the conversation the American casually mentioned that he was fifty-five years of age and was looking forward to the time when he might retire before he got too old to enjoy life. The statement was met by a shout of laughter and the retort : " You are only a boy, altogether too young to retire. Your real work and value in life is just commencing." As the American looked around the table into the smiling faces of this grey-haired group of men all older than himself, and remembered the sixth precept of the Mitsui code, he realized that they were right. A man with all his faculties has no right to seek the luxury and ease of retirement as long as the world needs his services. These Mitsui directors, heads of the greatest commercial, financial and industrial organizations in Japan, with interlocking directorates and immense

PROPOSED MITSUI BUILDING

To House The Mitsui Gomei Kaisha, Mitsui Bank and Mitsui Trust Company, Ltd., When completed it will be the Largest Structure in the World Used Exclusively for Banking Business, and will cost to erect Yen 15,000,000



Architects: Trowbridge and Livingston, 527 Fifth Avenue, New York holdings in other enterprises, had reached the top of the ladder through loyalty and efficient knowledge of the business entrusted to their direction. When they grow too old or infirm to take an active part in the great organization they have helped to build up, they will retire as counsellors, to be consulted by their successors on all matters. "*The life work of a man lasts as long as he lives.*"

With such a code, breathing fair-play to everybody, asking only for the right to equal opportunity that will enable Japan to trade, and by that trade provide employment for the millions condemned to stay at home by the operation of exclusion laws in other countries, the Mitsui mirrors the sentiment of the Japanese nation. If the fundamental problem of Japan is to be solved by keeping the surplus population at home, absorbing the people into new industries, it goes without saying that the door to world trade must be maintained wide open so that their manufactured products may compete on terms of absolute equality. The philanthropists and capitalists of Japan may create the industries, but without the markets, industry is no solution to a problem as grave and pressing and the one confronting present-day Japan. These markets must be created, developed and held by fair treatment and honorable business methods. There are other Japanese trading firms in the field helping to expand these markets, but it is no reflection on their ability and usefulness to state that if Japan is to pull through in the struggle for existence along these lines, the brunt of the fight will be borne by their standard-bearer, the Mitsui Bussan Kaisha. This is the great task that the Mitsui firm, through their trading organization, has set for itself. To accomplish this requires courage, initiative, enterprise, a high order of commercial intelligence, and a perfect knowledge of foreign markets and exchange.

The Mitsuis have led the vanguard in the expansion of Japanese commerce, carrying the flag to all countries of the world where legitimate trading can be carried on. Following the blazed trail of the Mitsuis have come the consular and diplomatic officials. For these reasons the Mitsuis have acquired the reputation in Japan of being positive where others are negative, but this aggressiveness is merely a manifestation of the national necessity, compelling the Mitsuis, because of their great wealth and experience, to assume leadership in the vital struggle for existence which faces the people of Japan. Japan may be industrialized, but if she is to survive as a manufacturing nation, the Mitsuis will be her salvation. The future of Japan is therefore bound up in the future of the Mitsuis. If the Mitsuis should fail, the industrial structure of the nation would collapse like a house of cards. Herein lies the strength of the Mitsuis. It may meet with reverses, but it cannot fail. *The Mitsuis are Japan.*

When the Mitsuis took stock of their properties after the earthquake and fire had wiped out the best part of Tokyo, they found that their handsome headquarters at Surugacho, as well as many branch offices in Tokyo and Yokohama, had been seriously damaged or reduced to ashes. The greatest organization in Japan was without a home, but only for a day. There was little hope of finding quarters or of erecting them within reasonable time, so the entire staff was brought together and business resumed in the palatial Mitsui mansion at Mita-Tsunamachi in Shiba. In this temporary headquarters, filled with the priceless art treasures of Japan, the Mitsui companies, under the personal control of their Director-General, Dr. Takuma Dan, buckled down to their task, and despite a handicap that would have broken the spirit of any ordinary organization, easily assumed the leadership in the great work of reconstruction that followed.

Hand in hand with the pressing demands upon their time to furnish supplies for the stricken area went the special relief work planned by the heads of the family. For many years the Mitsuis have endowed and conducted the largest charity hospital in Tokyo. It was founded in 1908 with an endowment of Y.1,250,000, to which a further Y.1,500,000 was added in 1919. Their other charities are legion, and on top of all this they set to work to erect barracks on their own account to house the homeless multitudes. From the first stage of the calamity the Mitsuis were in the van of rescue and relief work. Their numerous steamships, launches and lighters in the harbors of Tokyo and Yokohama saved thousands from perishing by fire or drowning. Anchored at Kobe, awaiting cargo and sailing directions, were several steamships belonging to the firm, and when communications with Tokyo and Yokohama were suddenly severed the Mitsui manager at that port, with a prescience of what it meant, hastily loaded a steamer with food and supplies and dispatched it under full speed to Yokohama. The first vessel to arrive with relief supplies after the disaster flew the Mitsui house flag, another reminder that "Business is humanity."

When Tokyo and Yokohama were cut off from the rest of Japan, the Mitsuis dispatched employees to all the cities and towns along the routes, and by relays of automobiles, motor cycles and other conveyances maintained communication between the Hokkaido and the Kansai district, while from Otaru, Nagoya, Osaka, Kobe, Nagasaki and other ports of Japan came a regular procession of steamers either owned or chartered by the Mitsuis, conveying supplies for relief work. The task then commenced has been carried on with unabating energy, the Mitsuis transporting, importing and supplying materials and machinery for public works and reconstruction from all parts of the world.

When the flames swept over Yokohama the Mitsui branch office suffered the general fate, but the silk warehouse of the firm miraculously escaped destruction. That warehouse contained several million yen worth of undamaged silk, and enabled Japan to carry on with the export of its prime commodity, an incident in the silk trade which had a rather disastrous effect upon certain Chinese silk operators who tried to take advantage of Japan's misfortune.

When the Emergency Relief Bureau was organized to assume control over the distribution of the vast quantities of supplies that came pouring in from all parts of the world, and the American Government designated General Frank McCoy and Colonel George Langhorne to act as the representatives of the American Red Cross in Japan, it was a Mitsui director who was appointed to head the Japanese Committee that accepted and distributed these supplies to the sufferers. In seeking for the proper man to work in harmony with the American mission, the Japanese Government most wisely selected Mr. Tokutaro Sakai, director of the Mitsui Gomei Kaisha and president of the Harvard Club of Japan, to head the committee composed of men from the leading families of Japan, whose names were a guarantee that the supplies would be distributed where they were most needed. Night and day for three months Mr. Sakai and his staff labored with hardly a respite, in order that the huge job of distributing the stream of supplies might be accomplished without a hitch. To his executive ability, tact and unvarying good nature under the most trying circumstances, is due to a large extent the success that crowned the work of the American relief commission.

All this time the Mitsuis were without a home. The Government injunction against the erection of permanent buildings until the new city plan could be decided upon was accepted by them without demur, and they were one of the first to give their consent to the new replotting scheme involving the surrender of much valuable land to the city. In the general disaster the Mitsui Bank Building was not so seriously damaged that it could not be repaired, and as soon as possible this branch of the organization returned to its quarters in Surugacho and reopened business at the old stand. The other companies were not so fortunate, and were housed in temporary barracks erected in the compound of the Mitsui Club in front of Hibiya Park. The Mitsui Gomei Kaisha and the Mitsui Trust Company have their offices in the building facing the park, while the Mitsui Mining Company and the Mitsui Bussan Kaisha are quartered in the temporary structures which fill the Club compound in the rear. There is little difference between these buildings and those erected for the Government offices that were destroyed. The vast turn-over that characterized the Mitsui activities before the disaster has expanded under these temporary conditions to a still greater volume.

Repair work on the old Mitsui buildings at Nihonbashi are proceeding rapidly. Two of these structures are again ready for occupancy, and with the addition of another temporary building, the Mitsui Bank, the Mitsui Bussan Kaisha, the Mitsui Mining Company and the Toshin Soko (the Mitsui Warehousing Company) will remove to these quarters in the near future. The present premises of the Mitsui Bank will then be demolished in order to erect on the site what will be the most imposing office building in Asia.

This building, illustrated on the preceding page, will easily take its place as the finest in Asia, comparing favorably with the largest buildings in the world. It will be of steel and reinforced concrete faced with Japanese granite, thoroughly fire and earthquake-proof throughout. The preliminary plans call for a five or six-storey structure, 415 feet long by 153 feet wide. It will face three streets, having sixteen enormous fluted Corinthian columns 76 feet high on the main front and eight columns of the same dimensions on each side. The steel work of the building will follow plans laid down by S. C. Weikopf, a New York engineer with offices at 11 East 42nd Street. The basements and ground floors will be occupied by the Mitsui Bank and the Mitsui Trust Company. The basements will be devoted entirely to an enormous system of safe deposit vaults of the latest and most approved model. Over 10,000 boxes will be installed for the safe custody of the Mitsui papers and for the use of their customers.

The proposed building has been designed by Trowbridge and

Livingston of New York, one of the best-known firms of American architects who have distinguished themselves by designing other great edifices in America and Europe, such as the Bankers' Trust Building in New York, the New York Stock Exchange, St. Regis Hotel, Altman Department Store, the Palace Hotel of San Francisco, and the Mellon National Bank of Pittsburg. The contract for the erection of the building has been signed with the construction firm of James Stewart & Company, of 30 Church Street, New York, at a total cost of Y.15,000,000. This concern also enjoys a high reputation for the quality of its work, having erected the State Capitols at Salt Lake City, Oklahoma City and Boise City, the Jefferson Memorial and the National Bank of Commerce in St.Louis, First National Bank buildings in Denver and Houston, and many other prominent structures throughout America. In England they constructed the Savoy Hotel in London and the Midland Hotel in Manchester, and have also carried out work in France and South America. It is estimated that about Y.6,000,000 will be spent in America for steel, cement, vault doors, hardware, sanitary equipment and other materials for this building.

The Mitsui Bank

The Mitsui Bank was one of the first to reopen business after the disaster, as the loss to the building and furniture was very slight (not exceeding Y.56,000), and although many of its customers suffered more or less, they were all companies or merchants of good standing whose assets were not materially impaired by their losses. The Mitsui Bank is capitalized at Y.100,000,000, of which Y.60,000,000 is paid up. The reserve fund at the end of 1924 stood at Y.50,600,000, with deposits of Y.408,000,000 and loans of Y.3,230,000. The bank has forged to the front rapidly as a medium for financing foreign trade, and even during the chaotic and uncertain days following the earthquake, the bank opened new foreign branches in London and Bombay, and is preparing to open another branch at Sourabaya in Java. For many years the bank has maintained branches in New York and Shanghai, financing a large part of the vast business of the Mitsui organizations. With the three new branches and others that are contemplated, the Mitsui Bank seems destined to become one of the world's great financial institutions.

The Toshin Soko

In addition to their many other activities, the Mitsuis conduct one of the largest warehousing enterprises in Japan, operating under the name of the Toshin Soko. The familiar Mitsui trade-mark on these structures is a frequent sight along the waterfronts of Tokyo, Yokohama, Nagoya, Yokkaichi, Osaka, Kobe, Moji and Shimonoseki. In Tokyo the main Toshin Soko's warehouse stands on the bank of the Sumida river in Nihonbashi, the commercial centre of the capital, while across the river in Fukagawa are the grain and rice warehouses located in the center of the cereal market. The Yokohama reinforced concrete warehouses stand within the Customs compound, handling a large share of the imports and exports of that port.

The earthquake and fire destroyed many of the Toshin Soko's best buildings, which were immediately replaced with temporary structures pending complete reconstruction in reinforced concrete. The three-storey silk warehouse in Yokohama from which the bulk of Japan's silk exports is shipped, is to be enlarged by the addition of a new four-storey reinforced concrete building. At Shibaura, the water gate to Tokyo, new warehouses covering 71,000 square feet of floor area were erected after the catastrophe in time to store a large percentage of the relief supplies which came pouring into the city from all parts of the world.

This branch of the Mitsui activities has kept pace with its sister companies in reconstructing and extending its facilities. We find that its capital has been increased from five to fifteen million, and from 343,000 square feet on August 31, 1923, the Toshin Soko has not only restored the space destroyed in Tokyo, but has now available over 384,000 square feet, about 33 per cent. of the total warehousing facilities of the Capital. It was the same in Yokohama, where the 123,000 square feet pre-quake capacity has been extended to 198,000 square feet, about 37 per cent. of the total facilities of the port. The stocks carried in the Tokyo warehouses prior to the quake were valued at Y.21,399,205, and the latest returns show that they are now storing goods valued at Y.20,222,507, about twenty-five per cent. of the total stored in all other warehouses. In Yokohama the increase in the value of the goods stored by the Toshin Soko is phenomenal. Just previous to the quake the value was only Y.3,312,360, but the latest reports show a value of Y.31,593,586 out of a total valuation of Y.33,491,924 of all goods stored in that port.

In Nagoya and Yokkaichi the Toshin Soko's warehouses are generally filled with large stocks of imported cotton for the supply of the many textile mills in those districts. This is one of the most important functions of the Mitsui. It is not generally known that the Mitsui own ninety per cent. of the stock in the largest cotton exporting company in the United States, an organization with American personnel which ships cotton not only to Japan and other ports of the Orient, but to Europe and South America as well. Their large interests in the textile industry of Japan have compelled them to eliminate middlemen, purchase the raw product from the planter, and ship direct from the Gulf Ports to Japan in order that the mills of that country may compete in the world's markets with their manufactured products.

In Osaka the Toshin Soko operates some 24,000 *tsubo* of warehousing space and has just completed a large reinforced concrete structure near the mouth of the Ajikawa River in close proximity to the harbor. In Kobe the Toshin warehouses connected with the piers and steamship side by railway lines, are a feature of the Customs compound. A new five-storey reinforced concrete warehouse is now under erection inside the Kobe Customs compound and the company is starting work on a reinforced concrete pier 600-ft. long and 120-ft. wide. The Nagoya warehouse has a capacity of 182,450 square feet, carrying stocks valued at nearly Y.2,000,000; the Osaka branch covers 854,000 square feet, storing stocks valued at Y.46,000,000; the Kobe warehouses cover 1,111,150 square feet, with goods stored to the value of Y.32,000,000. The toal warehousing area of the company is now 27,000,000 square feet. The total value of goods now stored by the various warehouses of the Toshin Soko is Y.150,000,000, or about one-third of the total warehousing business of the empire.

The Mitsui Trust Company

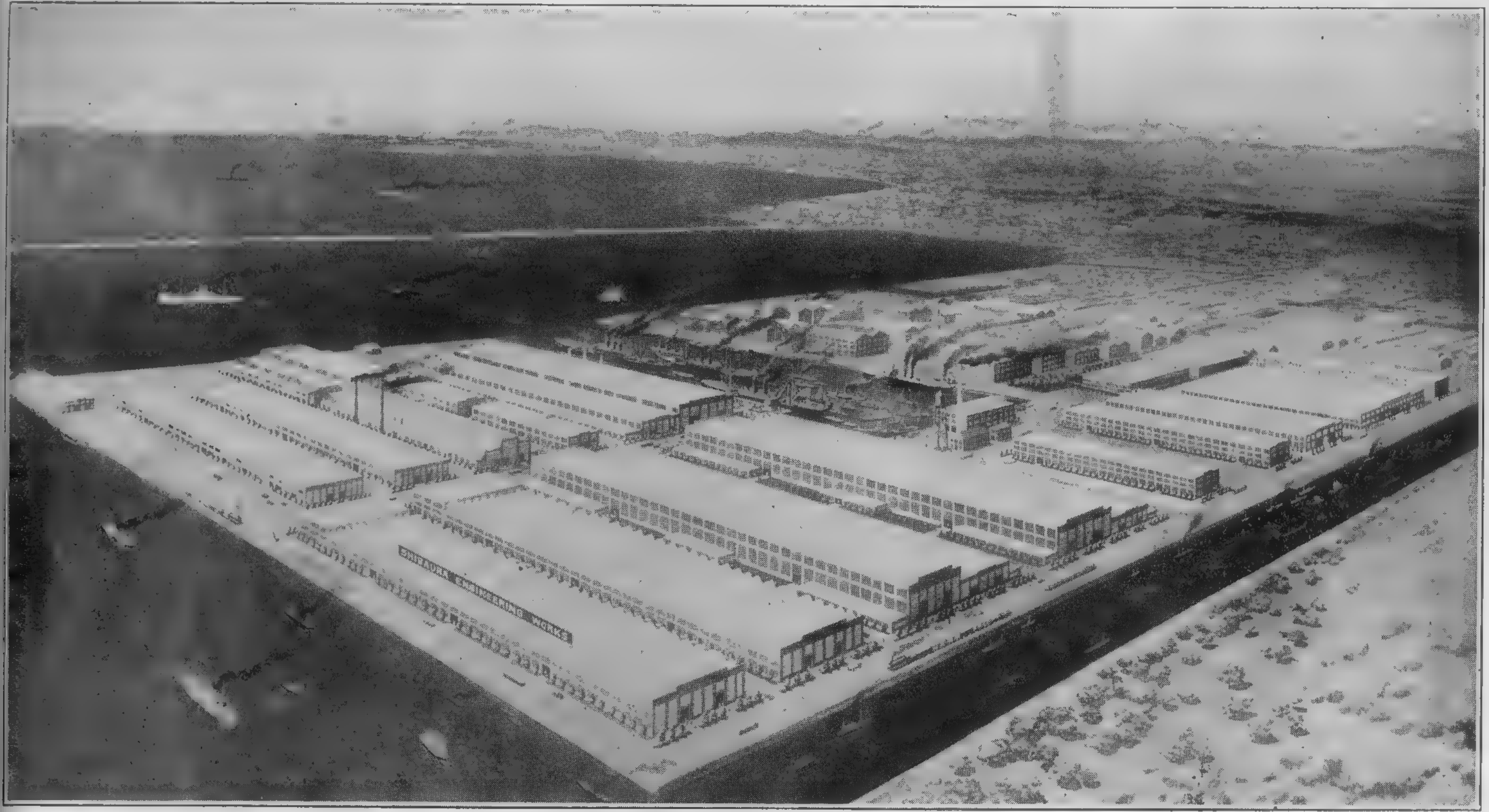
For many years trust companies had been carrying on an extensive and lucrative business in Japan, free from governmental supervision or regulation. As a consequence of this lax state of affairs over 500 concerns with an aggregate authorized capital of Y.347,000,000 had entered the field with a paid-up capital of only Y.109,000,000. Much of the business done was quite foreign to the established rules governing trust companies in other countries. Many companies were on an unsound basis. This situation became so flagrant that the Government appointed a commission to study the laws and workings of trust companies in Europe and America. The Japanese trust company law had been modelled somewhat on the lines of the German, but the Diet after careful consideration finally decided to adopt the spirit of the English system, passing a new law, which took effect January 1, 1923. Under its provisions a trust company must have a minimum capital of Y.1,000,000 and its activities restricted to the handling of trust funds, negotiable paper, monetary claims, movable property and real estate, leases and acting as trustees. In addition, all companies were required to obtain new permits to continue in business. This had the beneficial effect of wiping out all but thirty companies, which have applied for and received charters to date.

The first to file an application under the new law was the Mitsui Trust Company. The plans for establishing this venture had been drawn up by the Mitsui Council long before the earthquake, but it was not until after the disaster that in devising plans for reconstruction the Mitsui decided to launch the new company as part of their contribution to the financial machinery for the restoration of the city. The Mitsui Trust Company is capitalized at Y.30,000,000, divided into 300,000 shares of Y.100 each, of which the Mitsui Gomei Kaisha own nearly one-half, the remainder being in the hands of the Mitsui subsidiaries and individuals closely connected therewith. The functions of the new company will be the ordinary fiduciary acts provided by the trust law of Japan, supplemented by safe-deposit service; guaranty of credits; acting as agents in real estate or leases or in financing operations; insurance of public loans, corporate debentures, or corporate stocks; the disbursement of dividends; the handling of fiscal matters; and the purchase, disposal, or management of properties or liquidation of businesses.

As a result of the first year's operation, the company holds in trust over Y.43,000,000 in cash and Y.13,000,000 in securities, one of the strongest testimonials to the standing of the Mitsui in financial circles.

Although it is the latest addition to the Mitsui group, the trust company has a great future before it and will expand its usefulness with the increasing prosperity of its allied companies. In addition to the thirty trust companies operating under the new law there are

(Continued on page 534.)



General View of the New Plant of the Shibaura Engineering Works at Tsurumi, as it will appear when completed

"SHIBAURA"

The Model Industrial Plant of the Shibaura Engineering Works at Tsurumi will Revolutionize Japanese Manufacturing Methods

THE first construction stage of what will ultimately be the largest electrical manufacturing plant in Asia is now nearing completion on the reclaimed area at the new industrial centre of Tsurumi. Here, with deep water facilities for vessels of 10,000 tons, raw materials will be discharged and the finished products shipped out to all parts of Asia in competition with those of Europe and America. In fifty years of brilliant and successful operation, the Shibaura Engineering Works of Tokyo have arrived at that point where the demand for their electrical products is so great that it has been impossible for the manufacturing capacity of the plant to keep pace with it. Long before the earthquake, the erection of a new plant had been decided upon by the directors of the company, and at the time of the disaster construction had just been started.

The old plant at Shibaura, in Tokyo, covering an area of 20 acres, withstood the earthquake, but was reduced to ashes in the terrific conflagration which followed. The reconstruction and rehabilitation of this plant in the short space of four months is another tribute to the skill and capacity of the Japanese engineer. Temporary buildings were erected, machines and tools repaired and the works brought once more into full manufacturing swing. This, however, is merely an emergency measure in order to enable the company to meet the enormous demand for its specialties.

The work of foreign electrical manufacturing companies in Japan is kept constantly before the technical world by up-to-date publicity methods, and the fact is sometimes lost sight of that there exist Japanese manufacturers whose electrical machinery and apparatus is specified and installed in the majority of the new medium-sized plants now being erected. Among those who have established a high reputation for the excellence and efficiency of its products is the Shibaura Engineering Works. The enormous new plant now in process of erection at Tsurumi is an indication that the company not only intends to manufacture on a far larger

Large Machine Shop Pattern Shop Forge Shop

View of the Completed First Section of the New Plant of the Shibaura Engineering Works at Tsurumi, as it appears to-day. Looking North from Yokohama Side scale in the future, but is determined to get out and seek its share of the Asiatic electrical business.

The location of the new works is ideal. In addition to adequate harbor facilities, it has direct connection with the main line of the Japanese State railways. The yearly producing capacity of the Tokyo plant is valued at Y.20,000,000; what the output will be when the new works are operating to capacity is not difficult to foresee, especially as the whole force, from the president down, are imbued with the firm idea of placing their works and its products in the front ranks of the world's manufacturers of electrical machinery. The Company is under the direct management of its president, Mr. K. Iwahara, who has at his call the best engineering talent of the General Electric Company and the highly trained and expert engineers of his own country who have forced recognition of their merits from the engineers of other countries.

THE NEW PROJECT.—After some years of operation in quarters which became more crowded each year, it became apparent to the officials of the Company that present efficient manufacture and future expansion of operations demanded a new and more modern plant. In 1922 definite plans were launched to accomplish this.

In conceiving this project, they drew upon their own experience over a period of years, that of other plants operating in Japan, and the vast experience of the General Electric Company operating many similar plants throughout the world.

A very thorough preliminary study was made of all factors pertinent to design and operation, and out of this study grew a definite plan comprising sixteen separate buildings, individually fitted for a particular purpose, and collectively forming a complete manufacturing unit.

THE BUILDING PROGRAM.—The total floor space projected was 1,750,000 square feet, or approximately 40 acres, and the total estimated cost was $10,000,000.

It was decided to divide the construction into three stages, the first to consist of 350,000 square feet of permanent buildings and a temporary Power-house, the second to comprise 525,000 square feet, and the third to complete the balance of 875,000 square feet.

The buildings selected for the first stage were:

1.	Heavy Machine Shop No. 1	206,000	square feet
2.	Forge Shop	27,000	,, ,,
3.	Warehouse	76,000	,, ,,
4.	Pattern Shop	41,000	,, ,,
5.	Temporary Power-house		

THE SITE.—The site chosen consists of about one hundred acres of level ground situated in Tsurumi, a rapidly developing industrial centre between Tokyo and Yokohama. It fronts on to Tokyo Bay and is directly opposite the Port of Yokohama. The land has recently been made by hydraulic fill.

At the present time direct small boat service is available from Yokohama to three sides of the property. It is quite probable that in the future ocean-going steamers can be brought alongside, and complete docking, loading, and unloading facilities installed.

On the land side a railroad siding will be available connecting with the main line from Tokyo to Yokohama and the western part of the country.

PRELIMINARY STUDY.—Preliminary to any detailed design, an extensive study was made of all conditions confronting builders in Japan.

Of primary importance is the effect of earthquakes, which occur periodically and which vary in intensity from a very slight tremor to a most destructive shock. All available records extending over a period of years were studied, and from these and the advice of experts in Japan, a basis of design was adopted.

In the wake of destructive earthquakes there is an immense fire hazard due to the large numbers of closely-grouped, light frame, wood building. Fire spreads very rapidly. In the design of the buildings and their fire-fighting equipment every attempt was made to minimize this danger.

Other lesser factors ordinarily encountered in Japan, such as typhoons, high winds, extremely heavy rains, condensation due to a high atmospheric humidity, and extended periods of high temperature were investigated and special provisions made to overcome their effects.

DETAILED DESIGN.—The type of foundation to be used, one of the vital points in earthquake resistant buildings, was decided upon after carefully investigating all possibilities. The decision was to use reinforced concrete piles driven to a safe resistance, capped with concrete, and these caps in turn to be tied together with reinforced concrete beams. A total of nearly three thousand concrete piles were driven to support the buildings and their machinery loads.

The structural frames, either of steel or reinforced concrete, were designed to resist all loads in the buildings proper, and provided with bracing sufficient to carry earthquake loads directly to the foundations. All members and connections were carefully detailed in accordance with this design.

Exterior and interior bracing walls were in all cases constructed of reinforced concrete, and securely bonded to the frame. Stairwells and elevator shafts are in fireproof enclosures.

Floors are solid slabs of reinforced concrete.

The structural design as a whole was made with only one object in view, *i.e.*, safety of human lives and invested capital.

THE MACHINE SHOP.—This large building is approximately 310 by 850-ft. in plan. It is of semi-fireproof construction, having a heavy steel frame, a wood plank roof deck, and reinforced concrete exterior walls. It is divided by columns only into six aisles. The two heavy machine aisles are each 72-ft. wide and 48 and 40-ft. high respectively, under the trusses. One is served by a 75-ton and the second by a 15-ton craneway. The two adjoining light machine aisles are each 50-ft. wide by 24-ft. high. One is served by a 5-ton, and the other by a 2-ton craneway. On either side of the machine aisles are smaller side aisles used for offices, tool rooms, and various other special purposes.

The side walls and end walls are provided with large areas of ventilated steel sash and nine lines of continuous sash are used for the entire length of the building on monitors on the interior roofs. All overhead sash is mechanically operated from stations distributed through the building. This arrangement of sash provides excellent interior lighting and ventilation.

Special foundations on concrete piles have been built-in for all heavy machinery. A reinforced concrete floor has been laid over the entire area. Special cast steel testing floors were built in two places, and the balance of the finished floor is creosoted wood block layed on the concrete base.

The entire interior is painted gloss white. The combined effect of this paint and the large sash area is interior daylight, with no shadows in the building.

The railroad reaches the building at either end through large doors, which are provided with rolling steel shutters.

THE FORGE SHOP.—This building is approximately 173 by 209-ft. in plan, and of semi-fireproof construction similar to that of the Machine Shop. One end was made temporary, and concrete piles were driven for a future 400 foot extension of the building.

Special foundations on wood piles were built-in for the hammers and other heavy machinery. The floor over a part of the building is dirt, and the balance is concrete with cement finish. Mezzanine floors were constructed to accommodate tool rooms and toilets above the general floor level.

Large areas of sidewall sash and four lines of continuous sash in the monitor insure excellent lighting and ventilation. All overhead sash is mechanically operated.

The interior of the building is not painted.

Rolling steel doors are provided for railroad entrances at either end.

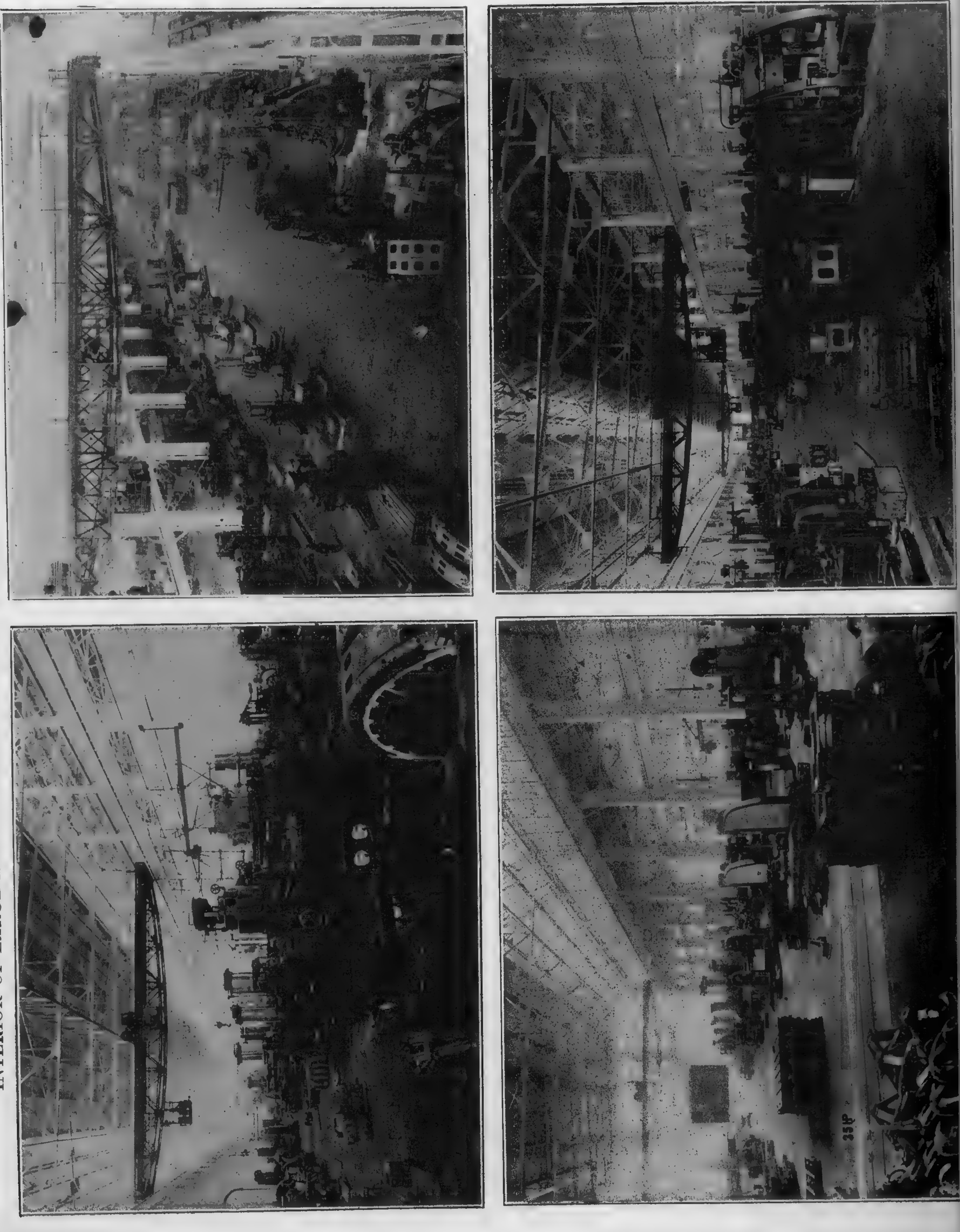
The main aisle is served by a 5-ton craneway and each of the side aisles by a 2-ton crane.

THE WAREHOUSE.—This building is approximately 69 by 368-ft. in plan, and is three stories in height. It is of reinforced concrete construction, flat slab type, and strictly fireproof throughout. The building is served by two elevators and two stairwells, one extending to the roof. These are entirely enclosed in concrete walls with automatic fire doors and rolling steel shutters. Toilets and wash rooms are built on mezzanine floors adjacent to the stairs.

Large units of sash are used in side and end walls at each floor level, these insuring ample light and ventilation in all parts of the building. Steel sash is used.

The finish floors over a large area are hard maple, and throughout the balance of the building, cement finish over the concrete slab.

A covered loading platform adjacent to the railroad siding extends along one entire side of the building at floor level, and at the level of the cars to be loaded. A cement finish is applied over this floor, and the canopy overhead is of wood plank on a steel frame.



INTERIOR OF LARGE MACHINE SHOP OF THE NEW SHIBAURA ENGINEERING WORKS AT TSURUMI

A small craneway is provided in each aisle on the first floor for handling materials for shipment.

Part of this building will be used temporarily for office space, and this interior has been painted gloss white with a dark green wainscote to a height of three feet above the floor on walls and columns. Stair wells are similarly painted. The balance of the building is plain.

THE PATTERN SHOP.—This building is approximately 69 by 298-ft. in plan, and is two stories in height. Construction is similar to that of the Warehouse, and strictly fireproof. The building is served by one elevator and two stair wells, all enclosed in reinforced concrete walls with automatic fire doors and rolling steel shutters. Large rolling steel doors are used in each end.

Finish floors are of maple and of creosoted wood block.

The interior is painted gloss white with dark green wainscote as in the Warehouse, and ample steel sidewall sash is provided for excellent light and ventilation.

THE POWER HOUSE.—This building is approximately 50 by 84-ft. in plan, and is of temporary construction only. The exposed steel frame is covered with corrugated siding and roofing. The building and equipment foundations are of reinforced concrete.

The power plant consists of two 600-horsepower boilers, one open feed water heater, two fire pumps, one service pump, three boiler feed pumps, three vacuum pumps, five fuel oil pumps, and two hydraulic pumps.

This plant supplies steam for heating, steam hammers, drying ovens, and other machinery, oil for the furnaces and pressure oil burners, and water at 400 pounds pressure for the hydraulic presses.

A system of reinforced concrete tunnels radiates from this plant to all buildings and carries steam, exhaust, return, oil, and hydraulic pipe lines. Expansion joints, all hangers, and anchors were carefully designed to eliminate danger of earthquake breakage.

BUILDING EQUIPMENT.—Each building, except the Forge Shop, has a vacuum heating system installed. The Machine Shop has in addition twelve steam unit heaters. All steam is supplied from the central power plant.

Special study was given to electric illumination. Fixtures were located, and shades were designed to produce an even distribution of light on a plane six feet above each floor. This eliminates all shadows, and makes individual machine lighting unnecessary.

All buildings have modern toilets, lavatories, and locker rooms in which all fixtures are porcelain china and connected with water and waste pipes. Each lavatory is supplied with hot and cold water. The Forge Shop has both shower baths and Japanese bathing pools.

A modern sewage disposal plant, including Biolytic tanks, pumping stations, dosing tanks, filter beds, and chemical treating apparatus has been installed to serve all buildings. Waste is carried through this system and discharged into the bay free from injurious bacteria. All the underground piping is laid on a concrete mat over wood piles and encased in concrete.

A separate underground system carries drainage from the entire property and the roofs, and discharges at ten different points into the bay. All piping in this system was laid with tight but flexible joints.

A complete automatic sprinkler system is installed and forty frost-proof, two-way fire hydrants. These are fed by a fifty thousand gallon elevated tank and two automatically controlled fire pumps of one thousand gallon per minute capacity in the Power House.

Water for toilet and manufacturing purposes is supplied by an automatic pump of one hundred gallons per minute capacity.

CONSTRUCTION.—Assembling of equipment and purchasing of materials for this unit of the project started just previous to the great earthquake of September 1, 1923. This caused a suspension of operations until December 1923, at which time construction work actually started. The work proceeded without difficulty and was carried through to completion in April 1925.

Structural steel, steel sash, rolling steel doors, and some few other items in the construction were imported. The balance of the material was purchased locally.

Construction was done by an American firm, who placed superintendents and assistants in charge, and the work was executed entirely with Japanese labor.

During construction, constant supervision, strict inspection, and regular tests were maintained to make certain that all items were actually built-in in the field as detailed on the plans and called for in the specifications, and that materials used were of the highest grade and properly applied.

MATERIALS AND QUANTITIES.—For the foundations under buildings and machinery, 2,615 special reinforced concrete piles were driven by the Raymond Concrete Pile Company of New York. The average length of pile was twenty-five feet.

For the Machine Shop and the Forge Shop, three thousand tons of structural steel were furnished by the American Bridge Company. This material was shipped partially fabricated.

Over 26,000 cubic yards of concrete were placed, including 1,500 tons of reinforcing steel. Cement was furnished by the Asano Cement Company, gravel and sand were obtained locally, and reinforcing steel was supplied by the Truscon Steel Company of Japan.

Bayley-Springfield steel windows were used. 95,000 square feet of sidewall sash and 54,000 square feet of continuous top-pivoted, sash were furnished and fabricated on the site by the William Bayley Company of Springfield, Ohio, U.S.A.

3,500 rolls of roofing and 1,100 barrels of asphalt were furnished by the Carey Company of Cincinnati, Ohio, and were applied by Z. Horikoshi & Company of Tokyo.

One and one half million pieces of wood block flooring were used. This material was furnished by the Nippon Wood Block Company of Tokyo.

About two million board feet of lumber were used throughout the work.

Piping installed on the site consisted of 18,000 linear feet of salt glazed tile pipe, 6,000 linear feet of copper downspouts, 12,000 linear feet of cast-iron pipe, 24,000 linear feet of heating pipes and steam lines, 13,000 linear feet of plumbing pipes, 11,000 linear feet of sprinkler lines, 6,000 linear feet of compressed air lines, 3,000 linear feet of gas piping, 4,000 linear feet of hydraulic lines, 3,000 linear feet of oil piping, thirty miles of electrical conduit, and 12,000 linear feet of asbestos covering used on steam, exhaust, and hot water lines. Tile and cast iron pipe was furnished largely by Mitsui Bussan Kaisha Ltd., of Tokyo. The balance was manufactured by the National Tube Company and the Nippon Kokan, and was furnished largely by Ishibashi Shoten. The Grinnel system of automatic sprinklers was used.

Other items of materials in lesser quantities, and too numerous to mention, were furnished by manufacturers in Tokyo, Yokohama, Osaka, and other parts of Japan. Prominent among these were Mitsui Bussan Kaisha Ltd., the Ishikawajima Dockyards, the Kodama Iron Works, Kensetsu Kogyosha, and many others.

The Shimidzu-Gumi organization of Tokyo furnished a large part of the labor used on the work.

CONCLUSION.—The first stage of this large development now completed, and embodying the best in plant design, buildings, and machinery, stands as a monument to the careful planning and executive ability which have brought it to this point.

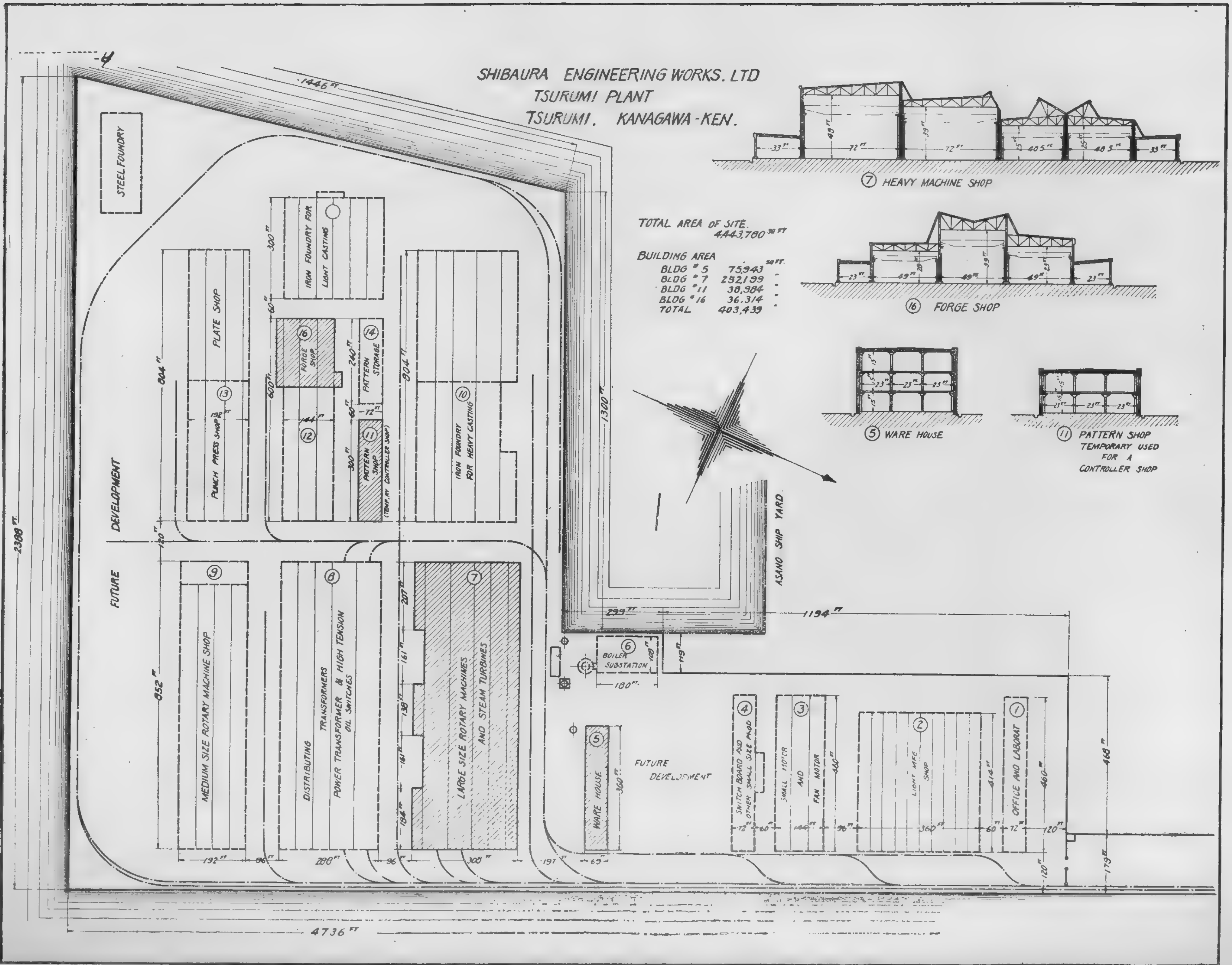
It marks the beginning of a new era of industrial building in Japan, in which larger and better buildings will be one phase of greater and more efficient production, which is the aim of all industries in their attempt to meet the competition of their own and other countries.

DESIGN AND CONSTRUCTION.—Plans and specifications for this work were made by the Shibaura Engineering Works, Ltd. The H. K. Ferguson Company of Cleveland and New York, U.S.A., were consulting engineers, and had the general contract for construction.

EQUIPMENT.—It is the intention of the Shibaura Engineering Works that the manufacture of electrical apparatus, in the new plant, shall be conducted on an equally efficient basis, as in the best American shops. With that end in view, a party of competent engineers from the Shibaura Engineering Works spent several months in America, studying the very latest practices, and the equipment used by the largest manufacturers. With the assistance of the manufacturing experts of the General Electric Company, the best obtainable standard machine tools, special purpose tools, and other equipment were purchased for the new plant through the Engineering Department of Mitsui Company. No expense was spared, the object being to purchase those tools which represented the last word in modern tool design and efficiency. All these machine tools are individually motor-driven.

The buildings already completed, and in which the machinery is largely installed, are as follows:

Large Machine Shop, consisting of four main bays, and two side bays, total length 850-ft., width 310-ft., area 264,000 sq. ft. This

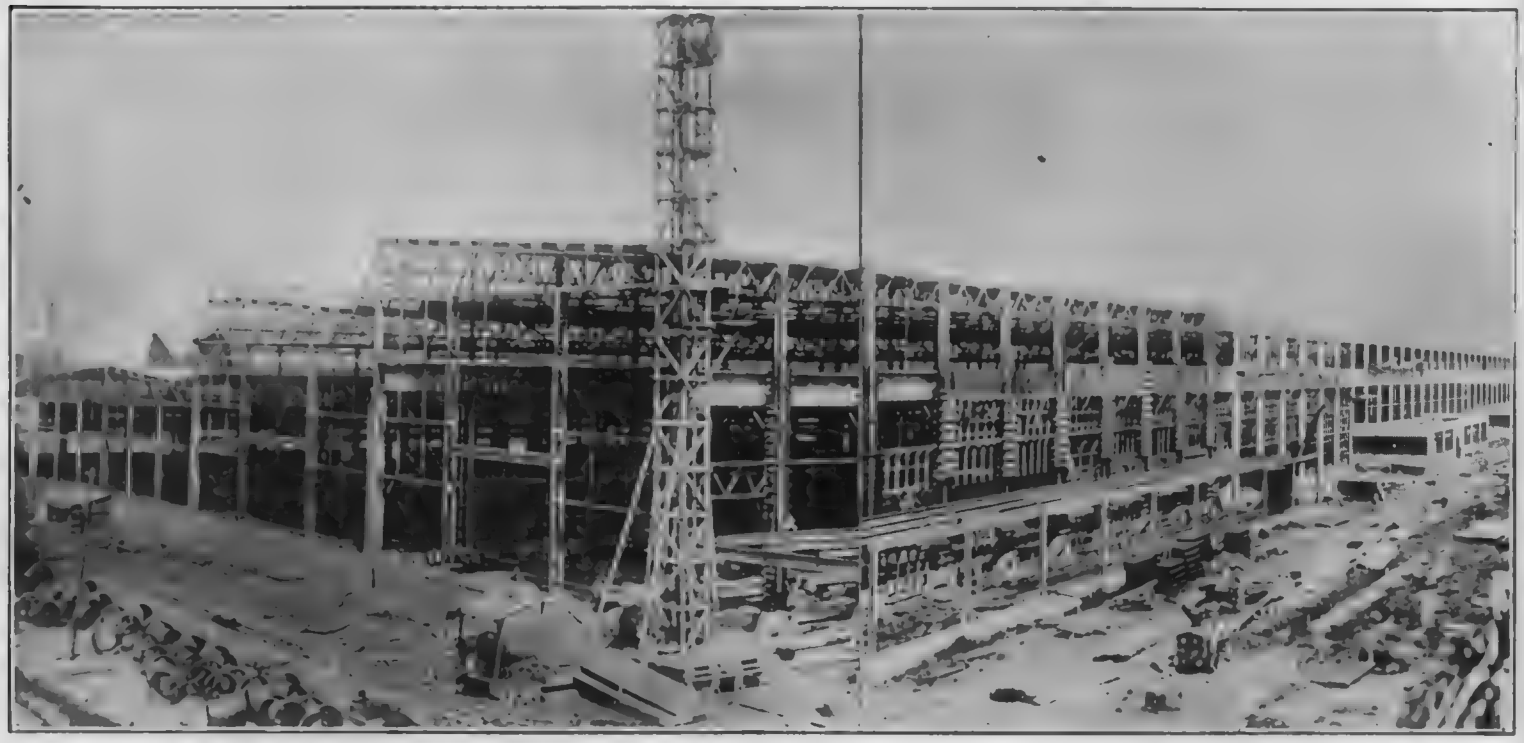


SHIBAURA ENGINEERING WORKS. LTD
TSURUMI PLANT
TSURUMI. KANAGAWA-KEN.

TOTAL AREA OF SITE.
4,443,780 SQ FT

BUILDING AREA
BLDG #5 75,943 SQ FT.
BLDG #7 252,199 "
BLDG #11 38,984 "
BLDG #16 36,314 "
TOTAL 403,439 "

General View of Machine Shop, Showing the Various Stages of Construction

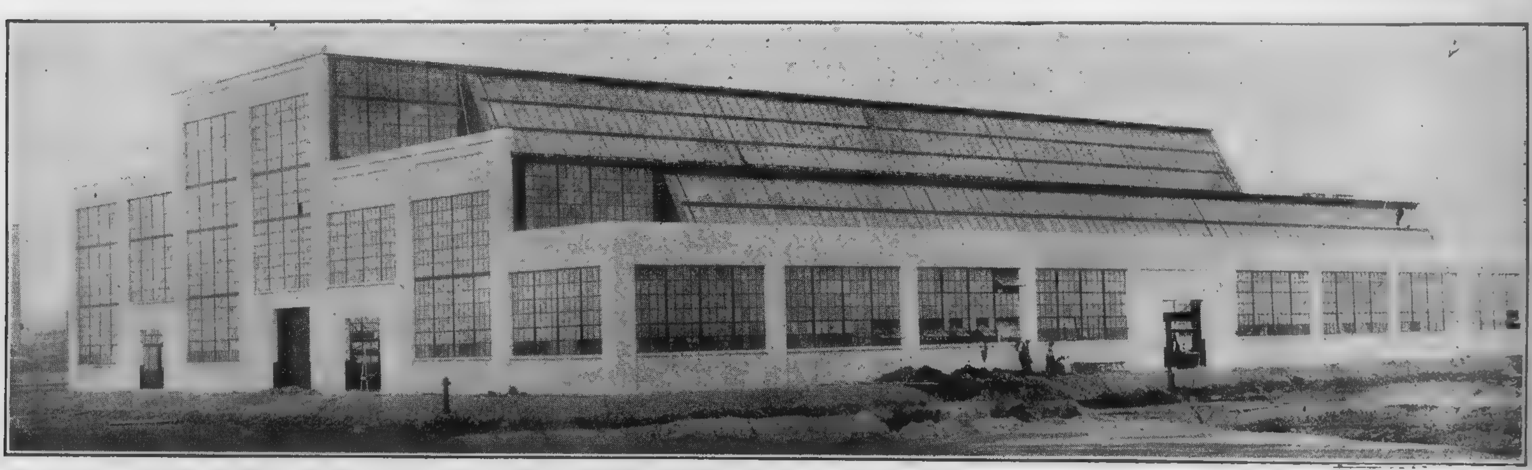


Machine Shop from West End

The Large Machine Shop of the New Plant of the Shibaura Engineering Works at Tsurumi, Showing the Building in Course of Construction and Completed

building is being equipped for the manufacture of A.C. and D.C. Generators for water wheel or steam drive, Rotary Converters, Synchronous Condensers, Steel Mill Motors, Railway Motors, D.C. and Induction Motors. The building will be served by electric travelling cranes ranging in capacity from 100 to 15-tons, with an ample number of jib cranes, and auxiliary hoists to serve individual tools, etc. This large shop, which for the present will contain the punch press, coil winding, and tool-making shops, is being equipped with steam and electric ovens, and electric furnces,a all designed for high efficiency, and absolute control.

Forge Shop: In the Forge Shop, with a floor area of 28,000 square feet, are now being installed a 500-ton Davy forging press, steam and air hammers, and oil-fired furnaces; the latter to be equipped with recuperators, and operated under conditions of high efficiency. As this shop affords sufficient space for the present; a portion of it will be used for a Plate Shop, Pipe Shop and Welding Shop.



The Forge Shop of the New Plant of the Shibaura Engineering Works

Pattern Shop : The Pattern Shop has been located temporarily in the warehouse, a three-story steel and concrete building, with a total floor area of 77,760 square feet. The very latest woodworking tools have been installed, and are in operation.

The building originally designed for the Pattern and Carpenter Shop is a two-story steel and concrete structure, with a floor area of 43,000 square feet. This building for the present will be used for the manufacture of electric control apparatus.

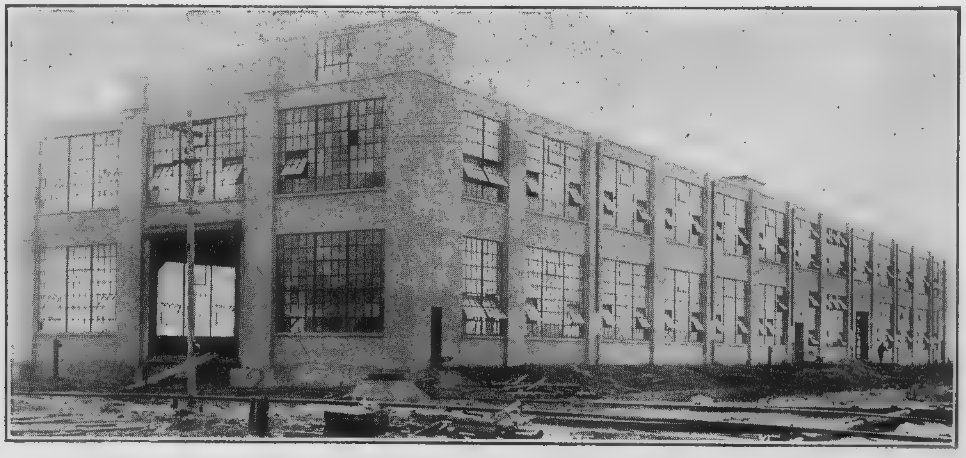
The warehouse, mentioned above, is of very substantial and fireproof construction, admirably suited to the purpose for which it was designed. For the present, and pending the erection of the office building, the warehouse will contain the executive and engineering offices, sufficient floor space remaining to serve its original purpose.

The floors of all of the buildings, where heavy machining work will be done, are of concrete and wood block, while iron floors of large and sufficient area are provided for large portable machine tool work, erecting, and testing purposes. As the percentage of glass area in all of the buildings is very high, the lighting is excellent, so that manufacturing of high order can be carried on under the best conditions obtainable.

It is the intention of the Shibaura Engineering Works to organize the work of manufacturing in the new plant, in the most efficient manner, and in accordance with the best modern practice. To ensure this, they have borrowed from the General Electric Company a manufacturing engineer, Mr. A. K. Warren, who for several years has been in charge of one of the largest manufacturing departments of the General Electric Company and other experts to supervise mechanical and electrical operations and foundry work, as well as an experienced man to assist in organizing the production, stock-keeping, and cost departments.

Among the largest machine tools to be installed at the present time are a 25-ft. Niles vertical boring mill, a 10-ft. by 10-ft. by 24-ft. Pond planer, an 84-in. by 30-ft. bed lathe, a 102-in. stroke Newton slotter, a 24-in. by 192-in. Norton cylindrical grinder, a 4-spindle Newton horizontal boring machine, a 10-ft. Cincinnati Bickford radial drill, a 6-in. spindle by 10-ft. Niles boring, milling and drilling machine.

A large number of heavy portable machine tools have been purchased, which will be operated upon a heavy iron floor which has been laid for the purpose; amongst these portable tools are two 96-in. and two 60-in. stroke Newton slotters, two 4-in. spindle by 8-ft., and two 4-in. spindle by 9-ft. Sellers boring, milling and drilling machines.



The Pattern Shop of the New Plant of the Shibaura Engineering Works

More than two hundred and fifty large and medium-sized machine tools were purchased in the United States, in addition to a large amount of special equipment, such as steam and air hammers, oil-fired forging and heat-treating furnaces, electric annealing and tempering furnaces, baling presses, metal washing and cleaning machines, coil winding machines, and impregnating equipment, etc.

The orders for machine tools and other equipment were well distributed; amongst those manufacturers receiving important orders may be mentioned :

The Consolidated Machine Tool Corporation of America, who furnished several Bett's heavy duty vertical boring mills.

The Niles, Vement Pond Co., Plainfield, N.J. : Heavy duty planers, horizontal boring, milling and drilling machine; Pond engine lathes.

Bethlehem Steel Export Corporation, N.Y. : Detrick and Harvey openside planers.

Bullard Machine Tool Co., Bridgeport, Conn. : Vertical turret lathes, maxi-mill type.

Potter and Johnston Machine Co., Pawtucket, R.I. : 6 C and 6 A automatic chucking and turning machines.

International Machine Tool Co. : 24 and 26-in. Libby turret lathes.

American Tool Works, Cincinnati, Ohio : Several large heavy engine lathes.

The Hendey Machine Co., of N.Y. : Tool-makers' lathes.

Barrett Machine Tool Co., Meadville, Pa. : Horizontal boring mills.

The Newton Machine Tool Works, Philadelphia, Pa. : Slotting machines, duplex, and slab-milling machines, etc.

William Sellers & Co., Philadelphia, Pa. : Large portable type boring, milling and frilling machines, universal tool grinders and drill grinders.

The Ingersoll Milling Machine Co. : Planer type milling machines.

The Van Norman Machine Tool Co., Springfield, Ohio : Duplex milling machines.

The Cincinnati Milling Machine Co., Cincinnati, Ohio : Plain standard, vertical and universal high-power milling machines.

The Norton Company, Worcester, Mass. : Large, medium and small cylindrical grinders; also universal tool grinders.

The Cincinnati Bickford Tool Co., Cincinnati, Ohio : Radial aud upright drills.

Warehouse Building

Interior of Pattern Shop

THE NEW PLANT OF THE SHIBAURA ENGINEERING WORKS

The Fitchburg Machine Works, Fitchburg, Mass.: Lo-swing lathes for shaft work.

Manning, Maxwell & Moore, N.Y.: Boye and Emmes lathes, etc.

Pratt & Whitney Co., Hartford, Conn.: Vertical shapers, die sinking machines, fig boring machines, centering machines, contour cutter grinders, etc.

Brown & Sharpe Mfg. Co., Providence, R.I.: Universal, plain and vertical milling machines, surface and universal grinding machines and small tools.

The Heald Machine Co., Worcester, Mass.: Internal grinding machines.

Gisholt Machine Co., Madison, Wisconsin: Precision balancing machines.

J. N. Lapointe Co., New London, Conn.: Broaching machine.

Walter H. Forster Co., N. Y.: Bolt turning, facing and centering machines.

Landis Machine Co., Waynesboro, Pa.: Double-head bolt threading machines.

Ferracute Machine Co., Bridgeton, N.J.: External and internal notching presses.

Waterbury Farrel Foundry and Machine Co., Waterbury, Conn.: Bench presses.

Andrews & George Co., New York: Marshalltown throatless rotary shears.

Logerman Brothers Co.: Hydraulic scrap metal baling press.

Oliver Machinery Co., Grand Rapids, Mich.: A large variety of wood working machinery.

J. A. Fay & Egan, Cincinnati, Ohio: Woodworking machinery, drum sanders, belt sanders, etc.

Massilon Foundry and Machine Co.: Steam hammers.

Nazel Engineering Machine Works: Air hammers.

Ferguson Furnace Co., Toledo, Ohio: Oil-fired forging and heat treating furnaces.

J. P. Devine & Co.: Impregnating tanks, vacuum pumps, compressors, etc.

Thomson Welding Co., Lynn, Mass.: Butt welders, spot welders, etc.

Raymond Concrete Pile Driver

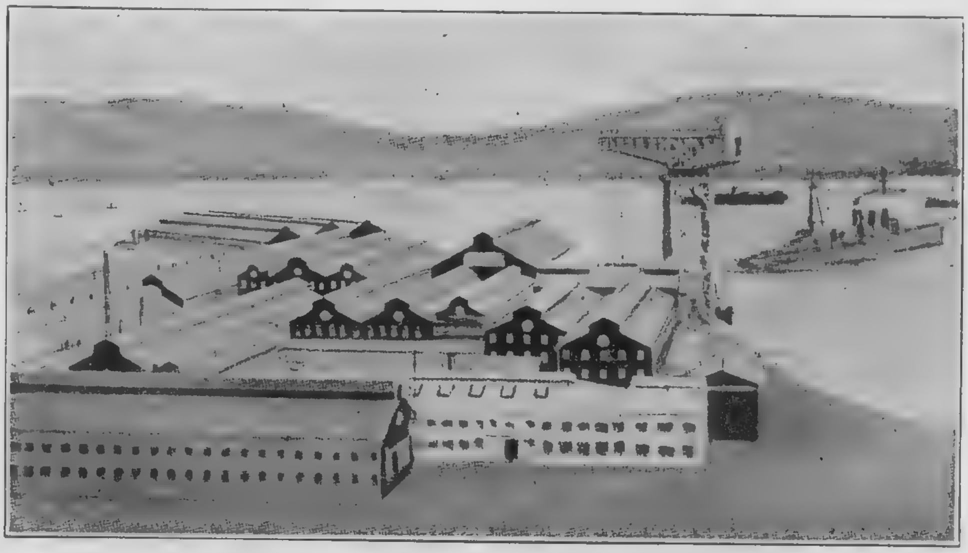
Laying Sewer Pipe

Warehouse and Water Tower

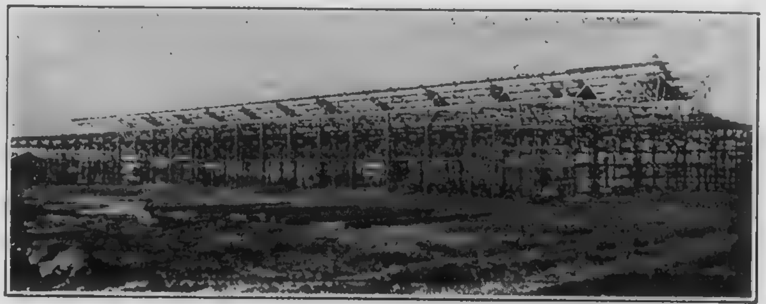
Electrical Manufacturing in Japan

The Mitsubishi and Hitachi Electrical Engineering Works

THAT the electrical services of Tokyo and Yokohama were restored so promptly after the earthquake and fire is due in large part to the remarkable growth of the electrical machinery industry in Japan, which is rapidly freeing the country from foreign importations in all except the heaviest units. While in no way minimizing the splendid co-operation of the great foreign electrical concerns in the rapid reconstruction work, it may be fairly said that on their Japanese competitors fell the task of furnishing the rush orders for the great bulk of the materials and machinery which made possible in such a short time the recovery of the tramway and lighting services of the devastated areas.



Nagasaki Works of the Mitsubishi Electric Engineering Co., Ltd.



Nagoya Works of the Mitsubishi Electrical Engineering Co., Ltd., to be completed in 1926

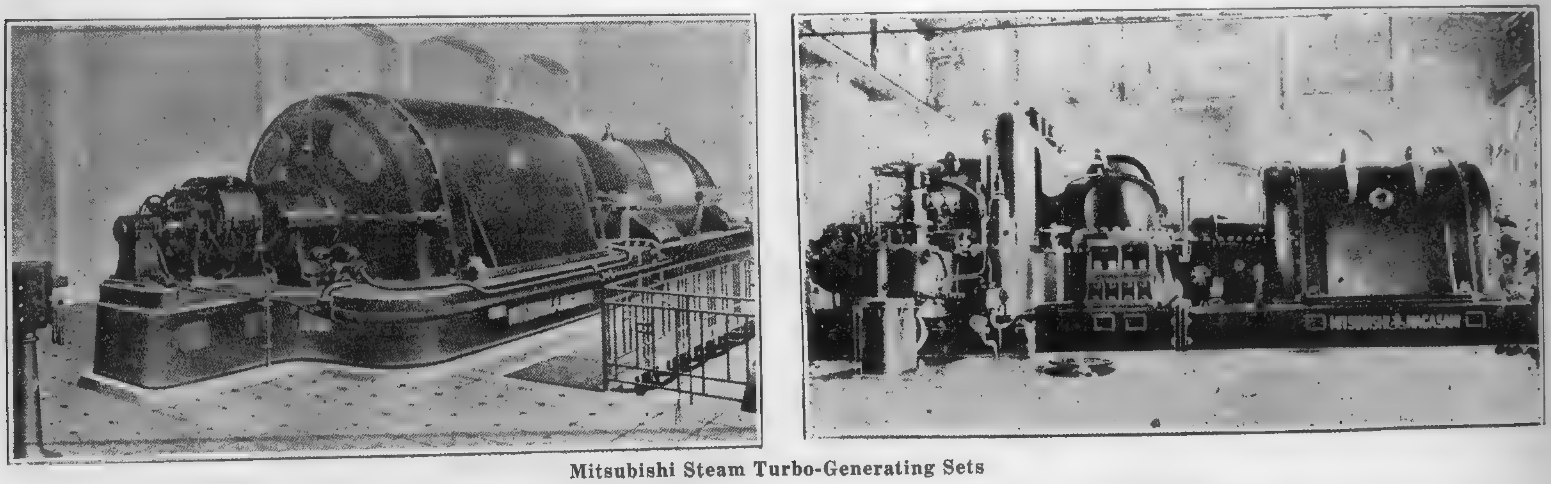
General View of the Kobe Works of the combined Mitsubishi Dockyard, Electric and Internal Combustion Engine Works at Kobe

The development of the electrical manufacturing industry in Japan to its present high state of efficiency has taken place in the comparatively short space of fifteen years. Before 1910 the few factories then in operation were occupied with producing the smaller types of machines and accessories, but as utilization of water-power increased and intensified the demand for generators, motors and the thousand-and-one specialties connected with the use of electricity, the producing capacity of these factories was rapidly expanded. At first the design and general efficiency of these Japanese-made machines fell below the standards of Western manufacturers, traceable largely to the inexperience of the Japanese mechanic and technician as compared with the generations of skilled training behind their fellow-workers in Europe and America. These defects are being rapidly overcome, and at the present time the design and finish of the products of the four or five leading Japanese manufacturers are equal to those of the best foreign makers. Due, perhaps, to the limitations of the market and the obstacles to large scale production, these Japanese machines are not very much cheaper than those imported from abroad. Another factor which militates against cheap production is the rather exaggerated scale of wages and living costs, combined with a lack of essential raw materials which have to be imported. In nearly all the accessory lines, such as meters, transformers, switchboard apparatus, insulators, copper and insulated wire, incandescent lamps, fans, etc., the Japanese manufacturing establishments are now able to supply the domestic demand and even to export a large part of their output to other Asiatic countries.

There are over fifteen manufacturers of electrical machinery and appliances in Japan whose products are noted for the high quality of their workmanship and efficiency, and although they have not yet arrived at that stage where their facilities permit the fabrication of the largest units, they practically dominate the home market for generating sets up to as high as 15,000 k.w. Amongst those whose products have achieved distinction stand the names of Shibuara, Mitsubishi, Hitachi.Fusi,Okumara, and the Dengyosha. The Shibaura Engineering Works, a Mitsui subsidiary, whose new plant at Tsurumi is fully described in another part of this journal, works in close co-operation with the General Electric Company of America, enjoying all manufacturing rights to its patents as well as an interchange of experts. The new plant is being erected with the set purpose of revolutionizing Japanese manufacturing methods along lines of American efficiency that will permit the company to market its products not only in Japan, but in other parts of the Far East in competition with American and European manufacturers.

The Mitsubishi Electrical Engineering Company

The Mitsubishi Electrical Engineering Company is another of the large Japanese electrical machinery manufacturers that has forged ahead, and



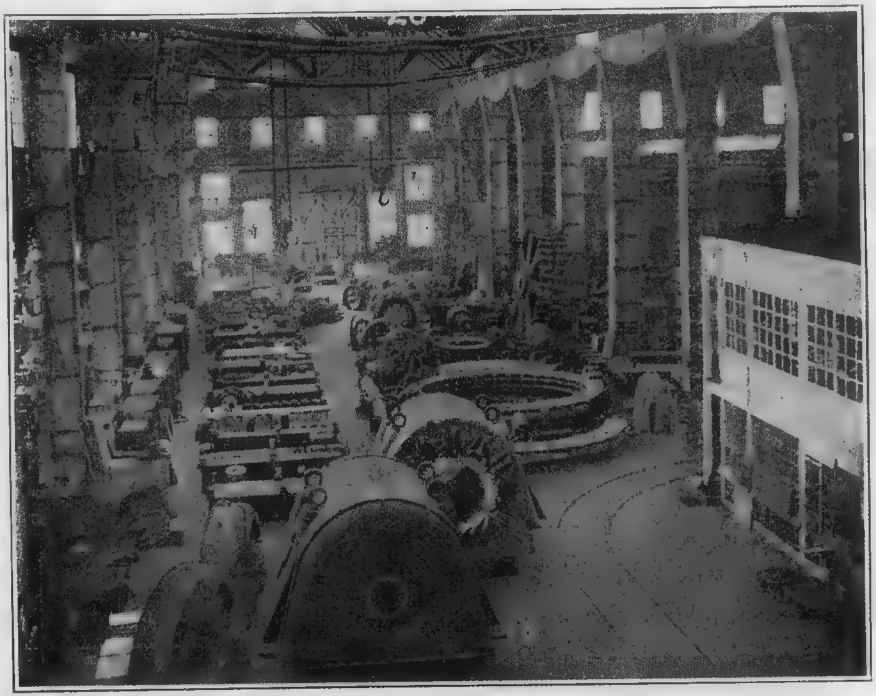
Mitsubishi Steam Turbo-Generating Sets

8,000 k.w. Generator Set

12,500 k.w. Set

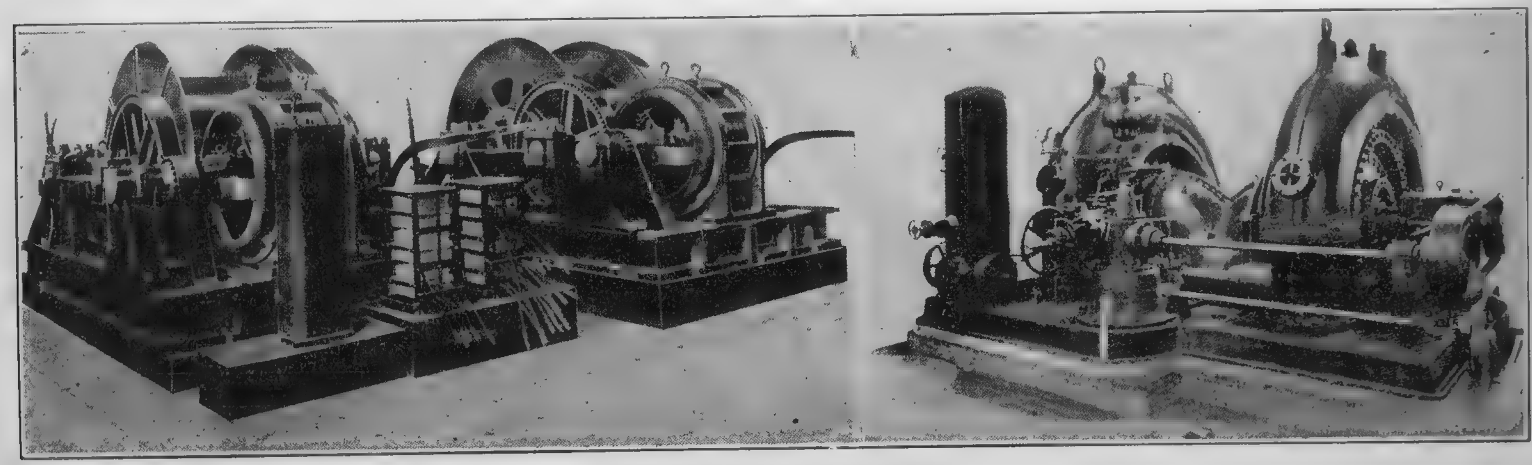
built up a great domestic business in the face of foreign competition.

We had hoped to include in this number of THE FAR EASTERN REVIEW a detailed description of the activities of the Mitsubishi Electrical Manufacturing Company, whose organization and facilities enabled it to take such a prominent part in the rapid restoration of the electrical services in the devastated areas. The publication of this article must be deferred for some future number of this magazine.



Electric Erecting Shop at the Nagasaki Works of the Mitsubishi Electrical Engineering Co., Ltd.

The activities of the great Mitsubishi Consortium are so varied and widespread that it would require another special number of this magazine adequately to describe their many manufacturing and engineering plants. In the electrical field the Mitsubishi stands as one of the pioneers in developing the industry in Japan to its present proud position, being compelled to undertake the manufacture of electrical machinery and appliances in order to fill the big demand for ships constructed at their Nagasaki and Kobe shipyards and to supply the many mines and collieries owned and operated by their mining department. In exactly the same manner that the Shibaura and Hitachi Engineering Works and nearly all other prominent Japanese industrial undertakings were developed from purely private plants into great manufacturing concerns, the Mitsubishi Electrical Manufacturing Company had its origin in an electrical shop established in 1905 at the Mitsubishi shipyard at Nagasaki to manufacture electrical apparatus for their own requirements. This shop was followed by a similar one at the Mitsubishi Kobe shipyard, and both plants were soon called upon to manufacture electrical machinery for the general market. The rapid growth of the electrical industry during the war was met by a corresponding increase in the capacity of these plants until it became necessary to organize an electrical engineering company separate from the shipbuilding industry to operate them. This was done in February 1921, when the Mitsubishi Electrical Engineering Company, Ltd., was incorporated with a capital of Yen 15,000,000 and took over all the business of the Electrical Department of the Kobe shipyard with its assets and

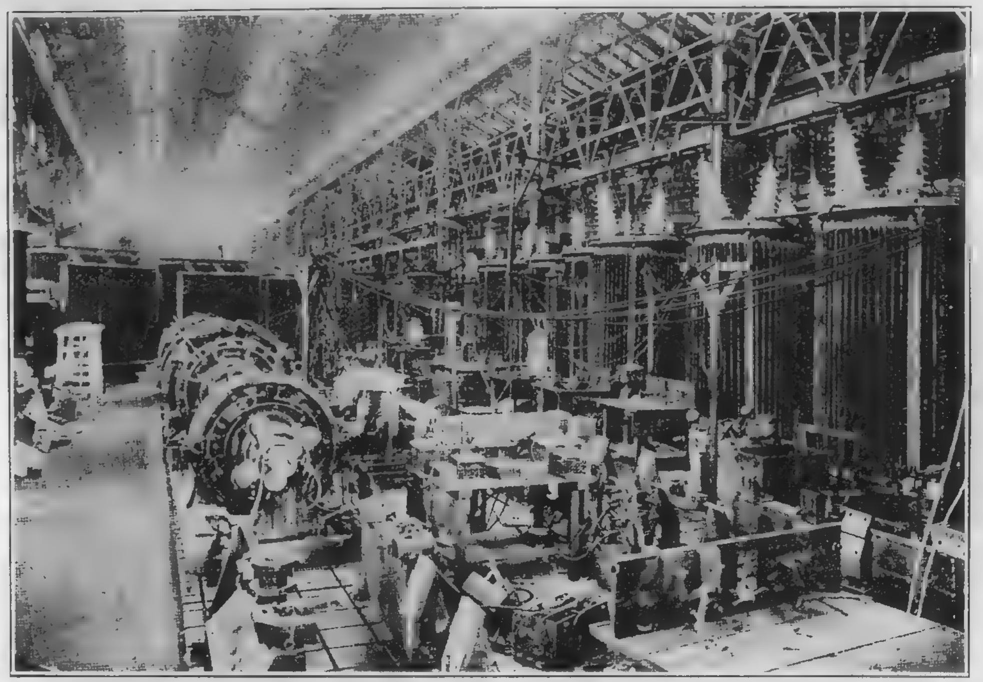


Mitsubishi Electrical Specialties

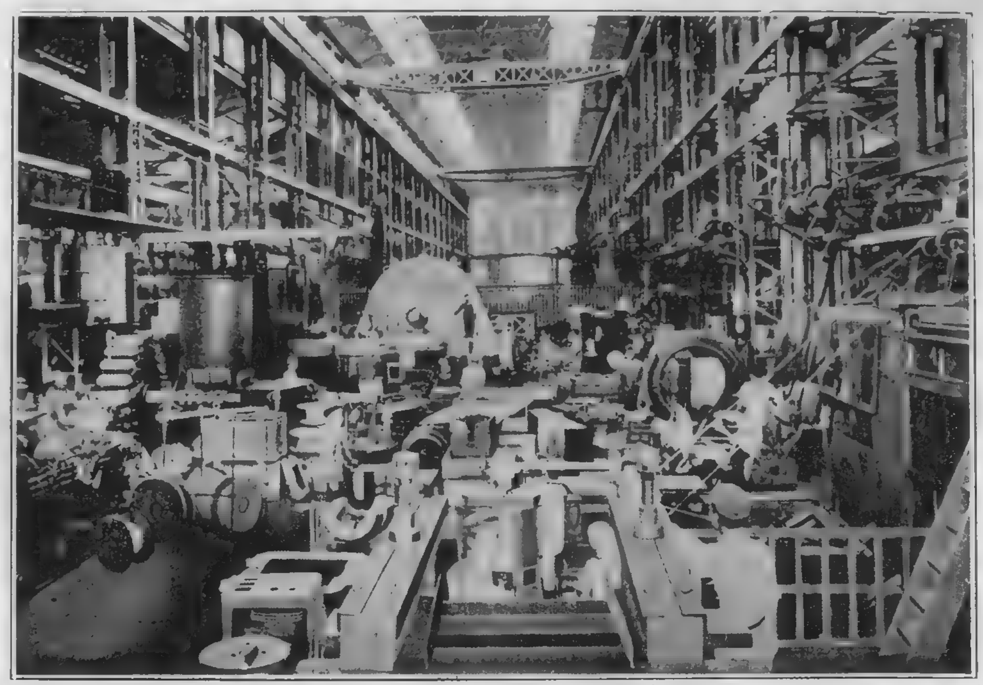
Single Drum Jaw Clutch Reversible Electric Winding Engine with Motor and Controller

10,500 h.p. Water Turbine

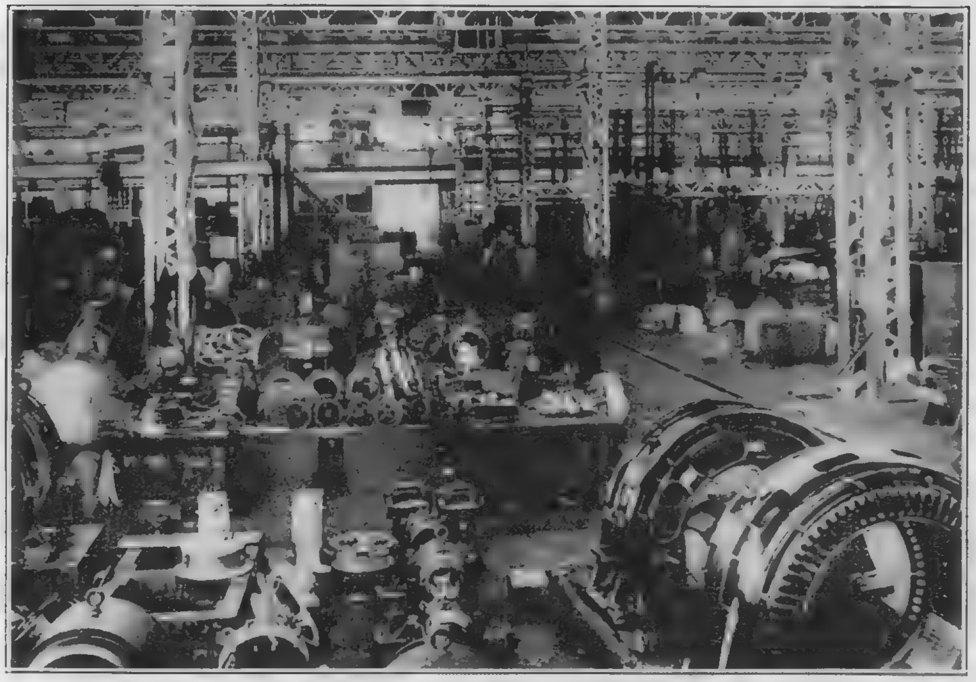
KOBE AND NAGASAKI SHOPS OF THE MITSUBISHI ELECTRICAL ENGINEERING CO., LTD.



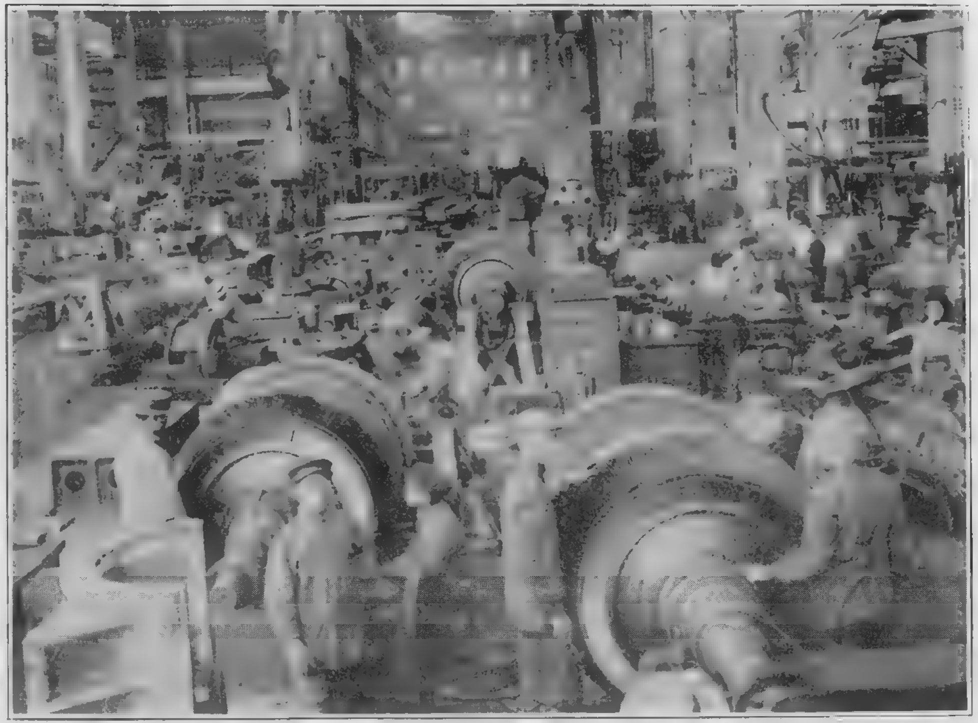
Transformer Testing Shop, Kobe Works



No. 2 Electric Shop, Kobe Works



Generator Shop, Nagasaki Works



Turbine Shop, Nagasaki Works

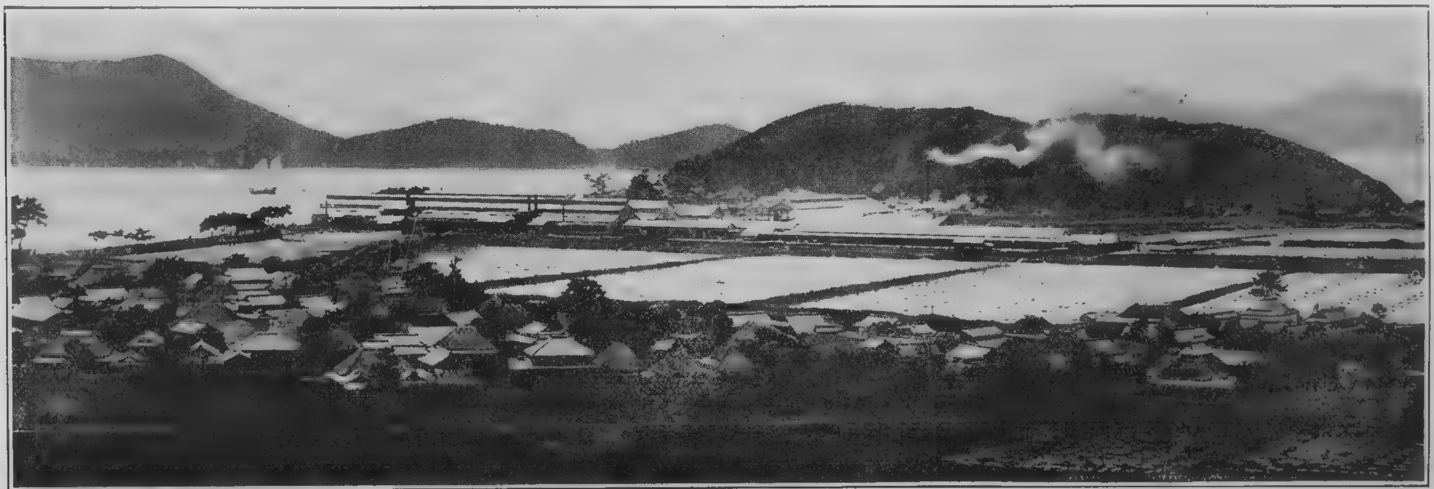
Hitachi Factory of the Hitachi Engineering Works, Ltd., located near Sukegawa, Ibariki Prefecture

liabilities and a site purchased at Nagoya for the erection of a new works. The Electrical Department of the Nagasaki shipyard was then absorbed, giving the new company three of the best engineering plants in Japan for manufacturing purposes.

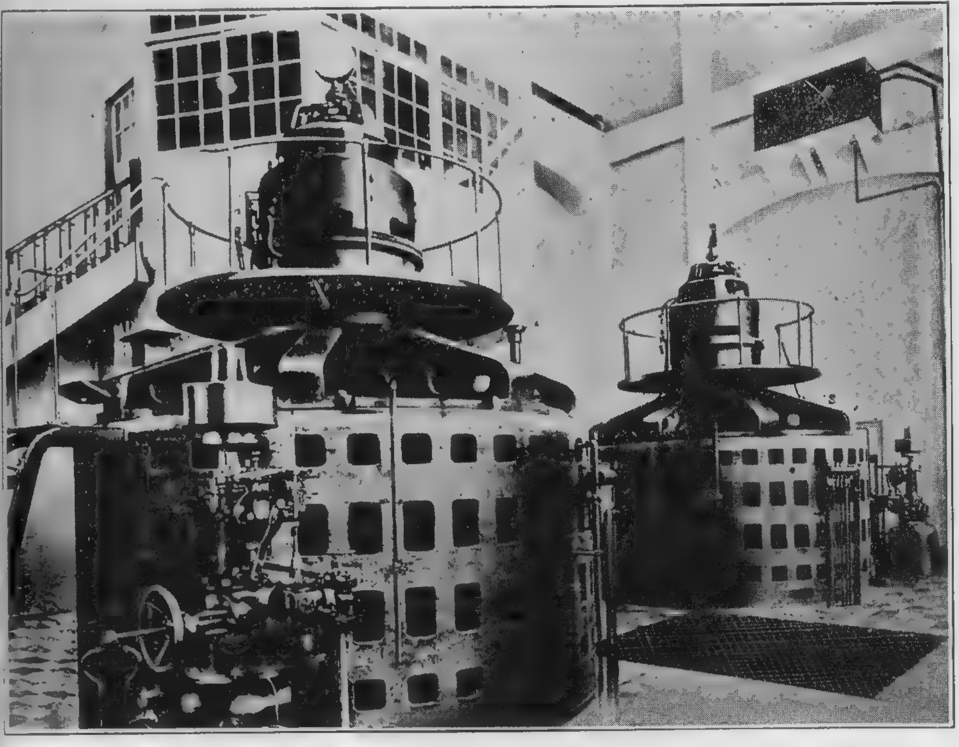
For many years prior to the organization of the Electrical Manufacturing Company, the Mitsubishi Company held the manufacturing rights for Parsons' steam turbines and alternators as well as the Ljungstrom turbines and generators. Many high-power sets for Japanese electrical plants had been turned out under these arrangements. Last year a working agreement was entered into between the Mitsubishi Electrical Engineering Company and the Westinghouse Electric and Manufacturing Company of America, under which the patents, designs and manufacturing knowledge of the latter company will become available for the Japanese company, a combination similar to that which binds the General Electric Company with the Shibaura Engineering Works and really strengthens the position of both Americans and Japanese in th Asiatic electrical world.

The Kameido Factory of the Hitachi Engineering Works, Ltd., located at Kameido, a suburb of Tokyo

The Nagasaki Works of the Mitsubishi Electrical Manufacturing Company are located in the south-eastern part of the city of Nagasaki, covering an area of 5,000 *tsubo*, with a floor space of 3,000 *tsubo*. This plant is complete in every respect and is noted for the high quality of its products. The Kobe works are located near Wada Point, at the south-western entrance to Kobe harbor, alongside the workshops of the Mitsubishi Shipyard and the Mitsubishi Internal Combustion Engine Works, and cover an area of 5,800 *tsubo*, with 4,200 *tsubo* of floor space. The works specialize in the production of direct current generators and motors, traction motors, synchronous motors and generators, induction motors, commutator motors, single phase and fan motors, rotary converters, special machines, phase advancers, phase converters, high frequency generators, frequency changers, transformers, turbo-generators,

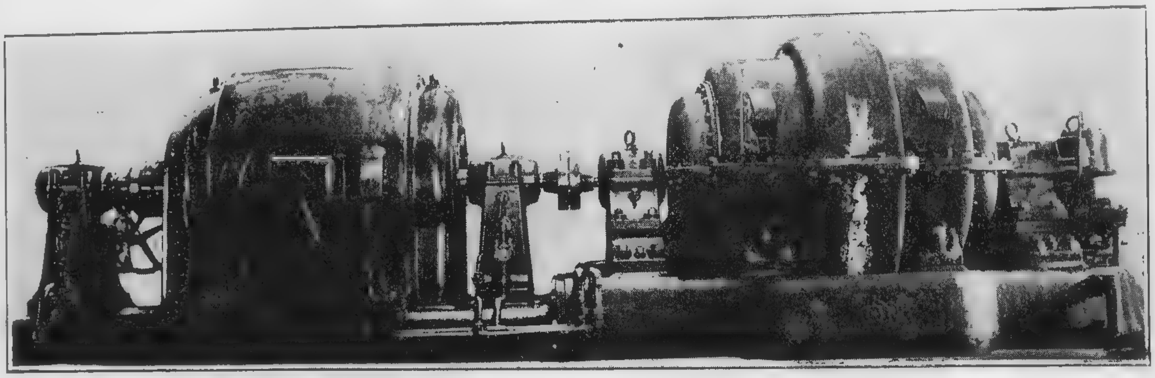


The Kasato Factory of the Hitachi Engineering Works, Ltd., located at Kasato, on the Inland Sea, in Yamaguchi Prefecture



Power House of the Kidogawa Hydro-Electric Company equipped with 4,440 k.v.a., 6,600 volt Generators driven by 7,400 h.p. Water Turbines furnished by the Hitachi Engineering Works, Ltd.

electric locomotives, switchboards and instruments, switch and controlling gear and all kinds of electrical motors for special purposes. Up to 1924 these works had turned out a total of 121,250 k.w. generators for land service and 7,914 k.w. for marine work.



360 h.p. Turbo-Blower made by the Hitachi Engineering Works

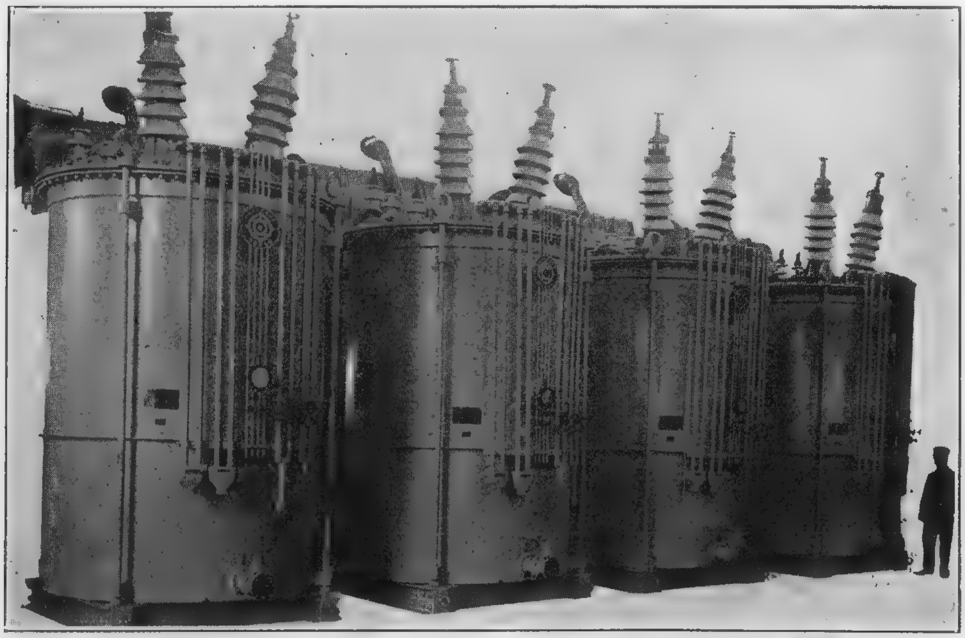
Its facilities and organization were maintained at such a high state of efficiency that when the great quake and fire destroyed the electrical communications of the stricken area they were able to supply immediately 1,500 50-h.p. traction motors for the Tokyo tramways, an accomplishment which did more to restore the tramway service than anything else. All these motors were combined with Westinghouse type air brake equipment manufactured at the Mitsubishi Works under an exclusive arrangement which gives them the manufacturing rights for Japan.

The new electrical manufacturing plant in course of construction at Nagoya will cover an area of 82,000 *tsubo*. The latest and most improved machinery and appliances are being installed, and the works when completed will be second to none in the Far East. With these three large plants, and the experience in engineering manufacturing enjoyed by the Mitsubishi experts and technicians, the new company will be an active and formidable factor in the Asiatic electrical market.

The third large Japanese electrical manufacturing concern is the Hitachi Engineering Works, Ltd., a subsidiary of the Kuhara interests, rapidly making a name for itself in the engineering world that is bound to become more widely known throughout the Far East. For the present these Japanese makers of high-grade machinery have been concentrating their energies upon solidifying their position in the home market before venturing afield, and for this reason outside of electrical circles very little is heard of their activities. During the war, however, many large generating sets bearing the trade-marks of these companies were sold in other Far Eastern countries, where they now stand as sign-posts pointing to future possibilities. The time is rapidly approaching when the improved equipment and manufacturing facilities of these plants will require a larger market in order to maintain them in full operation, and then with proper publicity the names of Shibaura, Mitsubishi and Hitachi will become as well known in the Asiatic market as the older-established foreign manufacturers of electrical machinery.

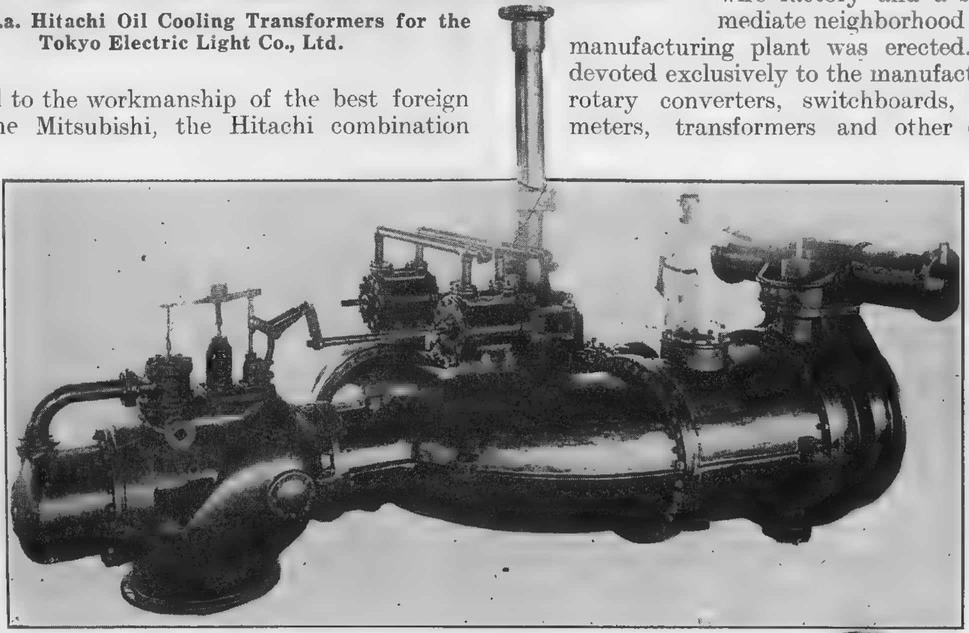
The first step towards this ultimate goal is seen in the new Shibaura plant at Tsurmi, to be followed by the Mitsubishi-Westinghouse and the Furukawa-Siemens combinations. The Kuhara interests have not as yet linked their fortunes with any foreign electrical manufacturing concern, but are developing along purely Japanese lines, feeling their way cautiously, increasing the size and capacity of their output until their works are now able to turn out 10,000 k.v.a. generating units and 59-ton electric locomotives for the Imperial Government Railways which

100-ton Hitachi Overhead Travelling Crane in the Generating Room of the Nagatsugawa Power House of the Shinyetsu Electric Company



10,000 k.v.a. Hitachi Oil Cooling Transformers for the Tokyo Electric Light Co., Ltd.

in every respect are equal to the workmanship of the best foreign manufacturers. Like the Mitsubishi, the Hitachi combination enjoys the advantage of combining with an electrical manufacturing plant two other engineering factories which turn out steam and water turbines, reciprocating engines, locomotives, mining and other machinery, enabling it to build complete units for any purpose. Its generating sets, both steam and hydro-electric, are now scattered throughout the empire in many of the important power plants.



5,700 h.p. Hitachi Turbine installed at the Power Plant of the Kinugawa Hydro-Electric Co.

The Hitachi Engineering Works

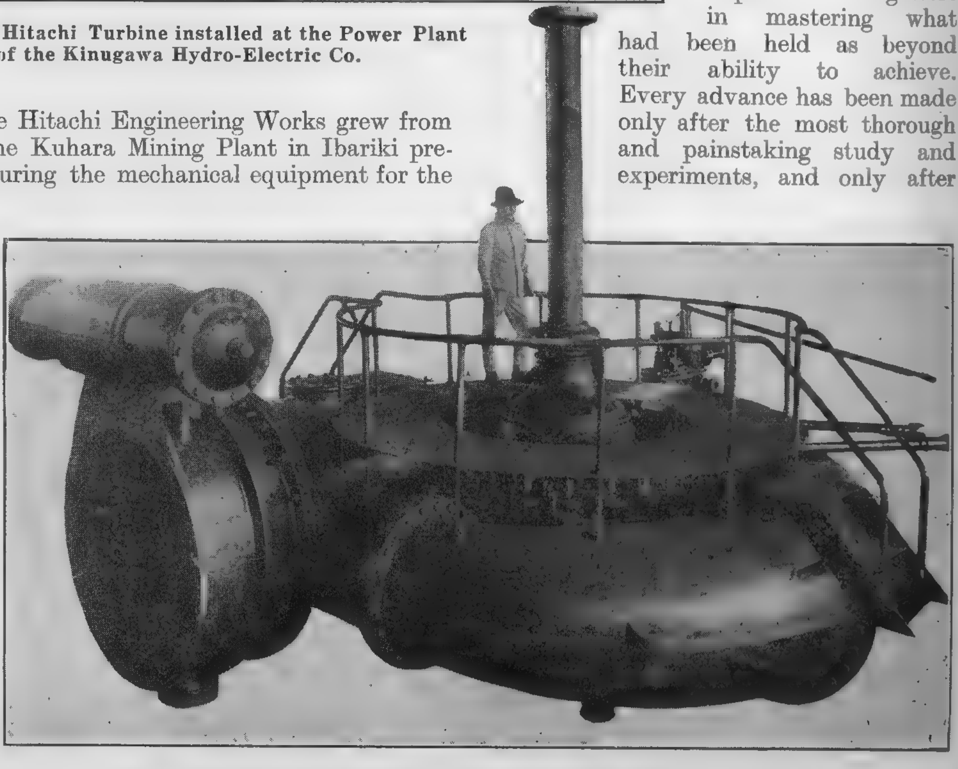
Like many other large Japanese enterprises, the Hitachi Engineering Works grew from a small beginning, being originally an adjunct to the Kuhara Mining Plant in Ibariki prefecture, created in 1909 for the purpose of manufacturing the mechanical equipment for the company's mines. The quality of the work turned out was so high that it was not long before the machine shop outstripped the private demands upon its manufacturing capacity, and two years later it was made independent of the mining plant and entered upon a general manufacturing career. When the Kuhara Mining Company, Limited, was organized in 1912 and took over the mining plant, the machine shop was incorporated in the new organization as the Hitachi Engineering Works. The great expansion of the plant as a result of the war induced the Kuhara interests to make another change by creating a limited company with a capital of Yen 10,000,000 to take over the works. The capital was half paid up at the time of its incorporation, and in the following year, when the company purchased the dockyard of the Nippon Kisen Kaisha at Kasato, the other half was called and paid in. With this plant and the Kameido works of the Kuhara Company in Tokyo, the Hitachi combination had three of the best-equipped engineering establishments in Japan for carrying forward its program. Their factories being located outside the earthquake area, the Hitachi Engineering Works were able to play a very important part in the reconstruction of the electrical services, restoring the rotary converters at the Kanda substation and the switching apparatus at the Eirakucho sub-station and repairing and equipping about 100 tramcars for the city of Tokyo. They are also furnishing more than eighty per cent. of the machinery and material for the extension and improvement of the Keihin Electric Line.

Hitachi Factory

From its inception the Hitachi Works ha specialized in the manufacture of electrical machinery, but in 1908 it added a complete plant for the manufacture of bare and insulated copper wire, copper plates and copper bars, and when the demand for its main products outgrew the capacity of the original works they were remodelled in 1920 for the exclusive use of the wire factory and a site purchased in the immediate neighborhood on which a new electrical manufacturing plant was erected. These works are now devoted exclusively to the manufacture of generators, motors, rotary converters, switchboards, fans, lighting arresters, meters, transformers and other electrical machinery, apparatus and accessories. The annual turnover is valued at about Yen 15,000,000, but the full-time output will add another five million yen to this figure.

Hitachi Specialties

In the short space of sixteen years the Hitachi Engineering Works has established a reputation to be proud of, reflecting the highest credit on the ability of the Japanese engineers in mastering what had been held as beyond their ability to achieve. Every advance has been made only after the most thorough and painstaking study and experiments, and only after



4,500 h.p. Hitachi Water Turbine for the Hiroshima Electric Light Company

Small Motor Finishing Room in the Kameido Factory of the Hitachi Engineering Works, Ltd.

Electric Machinery Shop of the Kameido Factory

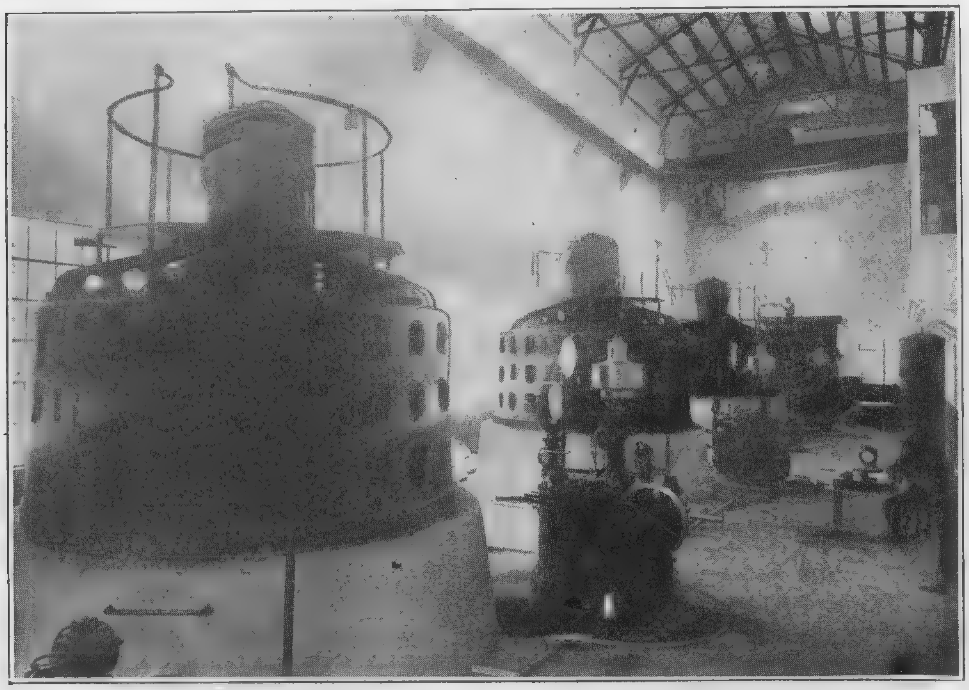
Large Electrical Shop of the Hitachi Factory

being assured of the quality of the product has it been placed on the market. The first small alternating generators were produced in 1909. In a few years the works were turning out high-speed 600 k.v.a. machines, and by 1920 had advanced to the stage where 1,000 k.v.a. turbo-generators operating at 3,000 r.p.m. were being made and sold in the market in active competition with foreign generating sets. The Takenosawa power station of the Kinugawa Electric Company (supplying the power for the Tokyo tramways) was then equipped with four Hitachi 4,444 k.v.a. vertical generators, and orders were then filled for 6,000 k.w. machines. For a long time it was considered that the Japanese could not successfully manufacture synchronous rotary converters, but here again the Hitachi Works demonstrated that this belief was unfounded, as in 1922 it turned out a 50 cycle, 600 volt, 1,000 k.w. machine, since when several other orders have been filled.

Aluminum lightning arresters for 66,000 volts alternating current bearing the Hitachi trade-mark and others for direct current are to be found in many of the power plants and sub-stations throughout Japan. The works also specialize in induction motors of large horsepower capacity supplied to mines, cement, paper and textile mills, for driving centrifugal pumps and blowers and for other purposes. High-speed induction motors have been turned out at the Hitachi works since 1911, when the first 275 h.p., 3,000 r.p.m. machine was made. Motors of over 600 h.p., operating at 3,600 r.p.m., are now among its standard products, while direct current motors for tramcars, cranes, hoists and other purposes, as well as for electric locomotives, have found a wide market.

Hitachi transformers are now accepted throughout Japan as equal to the best foreign makes, reaching the point where the works are now turning out 10,000 k.v.a. water-cooled apparatus. After overcoming many difficulties, three phase transformers up to 4,500 k.v.a. were made for the Aomi plant of the Electro-Chemical Manufacturing Company with a primary winding for 6,600 volts and secondary of 109 volts. They have also developed an oil circuit breaker of such merit that the Railway Department has installed 73,000 volt, 50,000 k.v.a. capacity breakers at the great Kawasaki sub-station, and the Daido Electric Power Company has one of 88,000 volt, 100,000 k.v.a. capacity at its Abiko sub-station.

In order to make the works self-contained, the Hitachi interests have also developed the manufacture of insulating paint and material for its own requirements and is now preparing



Komatsu Power House of the Tokyo Electric Light Company, equipped with 6,750 h.p. Water Turbines and 4,800 k.v.a., 6,600 v., 50-cycle Generators made by the Hitachi Engineering Works

to enter the market with these products. In the same manner they have perfected a high grade of oil for cooling transformers and circuit breakers which the Department of Communications has approved as being superior to the imported article. In the matter of electric meters, the Hitachi Works are now manufacturing apparatus of great accuracy, attaching them to all its switchboard work. They also own marble quarries located within two miles of the works from which are derived the slabs for switchboards, elaborated and polished at a special shop equipped with the most improved machinery.

Electric Locomotives

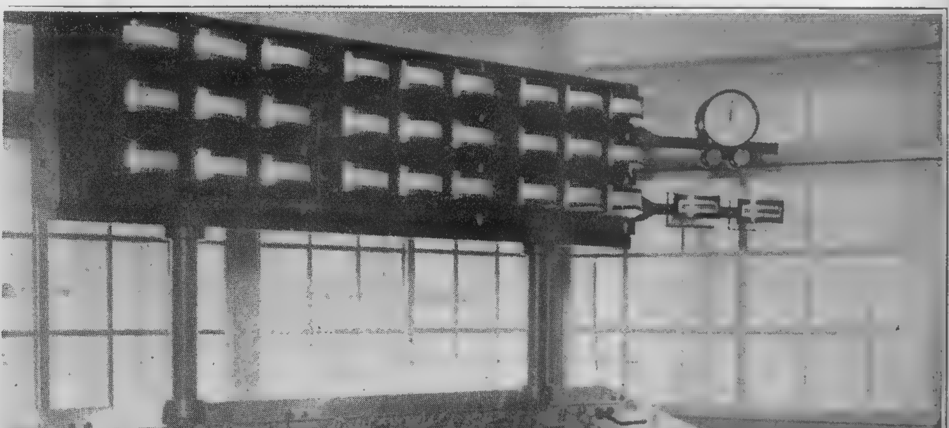
For many years the Hitachi Works specialized in the manufacture of electric locomotives for mining purposes, all the Kuhara mining properties being equipped with locomotives from these works. In acquiring the Kasato Works of the Nippon Kisen Kaisha the Kuhara interests were primarily concerned in utilizing this plant for the manufacture of steam locomotives as well as other heavy machinery. When the Railway Department determined to electrify the main lines and ordered eight test locomotives from approved western makers, following this up by placing orders for 36 with the English Electric Company, the Hitachi Engineering Works declined to accept what appeared to them as an official reflection on the ability of the Japanese to manufacture electric locomotives suitable for main line traffic. They had already successfully made electric locomotives for main line work in 1915 and were determined to prove their ability to meet all the requirements for the more important task of electrifying the State system. They set to work and turned out two main line electric locomotives on their own account, and so eminently successful were the trails that they were accepted by the Government and orders placed for two more. A prominent American electrical engineer who witnessed the test runs of these engines declared that they were every bit as good as any locomotive that could be turned out in America. "The Japanese can build electric locomotives as well as the best American manufacturers; the only point of advantage we possess," he concluded, "was in the matter of price. Due to our larger establishments and production capacity we can beat them in price, but not in quality." This high testimonial to the engineering ability of the Japanese is the best indication of how far they have advanced along lines which heretofore have been considered as a monopoly of the West, and if Japan should adopt a protectionist policy it would not be long before the Japanese manufacturers would supply all the requirements of their own market and reach out for foreign orders.

In the matter of steam locomotives the Kasato Works of the Hitachi Engineering Works are now amongst the three or four approved Japanese makers furnishing engines for the Imperial Government Railways, successfully making the largest 2-8-2 types, and supplying locomotives for the smaller private lines throughout the country.

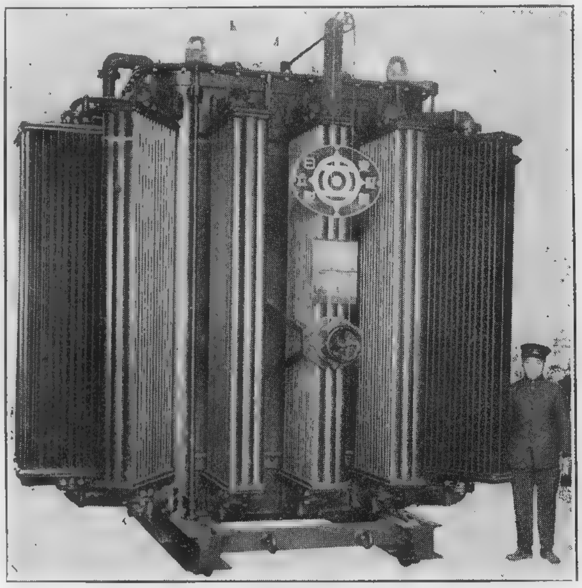
Water Turbines

In the same way they concentrated on the manufacture of water wheels which before the war were supplied exclusively by foreign makers. When the war cut off further importations, the Hitachi Works determined to meet the home demand, and at great sacrifice undertook the experimental work in this line of engineering. When the first three water wheels from this factory were installed and placed in operation their success wiped out all doubt as to the ability of the Japanese to compete in this work. One of these 10,000 h.p. water wheels installed at the Iwamuro power-house of the Tone Electric Company (now incorporated with the Tokyo Electric Light Company) after five years of continuous operation is maintaining a standard of 87 per cent. efficiency.

A vertical axle water turbine of 7,400 h.p. erected at one of the Kinugawa Hydro-Electric Company's power-houses is one of the longest and most unique in Japan, a duplicate of which was subsequently ordered in 1919 by the Hokkaido Electric Company. The Keihin Electric Power Company has also installed a 14,000 h.p. vertical axle Hitachi water wheel, one of the largest in Japan. From this to blowers is a natural step, although the Hitachi Works have been manufacturing this type of machinery since its establishment in 1909. This also was the first attempt to make these machines in Japan. In fact, the Hitachi Works have established



Hitachi Switchboard for the Kinugawa Power House



Hitachi Automatic Cooling Transformer, 4,599 k.v.a. 3-phase 69 cycles, 22,999-29,998 v : 11,888-18,888 v

such a high reputation for mining ventilators and blowers that it almost monopolizes the Japanese market, the latest type having a capacity of 45 cubic feet per minute at a pressure of 15 lbs., due to the development of high-speed electric motors. These blowers and turbine pumps are the specialty of the Kameido Works, there being no other factory in Japan producing a high lift pump. From 1909, when they manufactured the first 6-in. pump with a lift of 300-ft., they have developed this type to where it will lift 300 cubic feet of water per minute 4,500-ft. with 400 h.p. Many of these turbine pumps are to be found in the most important reclamation and river improvement works throughout the country, the Ibaraki reclamation using eight 36-in. diamter 300 h.p. and two 19-in. 100 h.p. pumps. They are also found in the new pumping stations of Tokyo's modern sewage system.

Kameido Factory

The Kameido Works, specializing in the manufacture of water wheels, turbines, cranes, pumps, ventilators, blowers, iron pipe and small size motors, are located in Kameido-machi, a suburb of Tokyo. The factory was established originally in 1908 at Tsukudashime, in the Kyobashi ward of Tokyo, for manufacturing machinery for the Kuhara Mining Plant. When the Kuhara Mining Company, Ltd., was organized in 1911, it was incorporated as part of this company under the name of the Tsukudashima Works, and, like the Hitachi Works, soon outgrew the private demands on its capacity, and was formally opened to supply the market with pumps, cranes, ventilating fans and other machinery. In 1916 the plant was removed from Tsukudashima to its present size and merged under the name of the Kameido Factory with the Hitachi works in 1918. In the following year the manufacturing plant for standard induction motors was transferred to this factory.

The earthquake and fire of September 1923 spared this factory, with the exception of a slight damage to the machine shop, which was quickly repaired and expanded during the following year. The works now cover 18,471 *tsubo* of ground area, with 6,353 *tsubo* devoted to buildings, employing about one thousand workmen and 111 in the office and technical staff. The value of the annual normal output of this plant is placed at Y. 4,800,000, with an emergency capacity of Y. 6,240,000.

Kasato Factory

The Kasato Factory situated in Shitamatsu-machi, in Yamaguchi prefecture, was originally the shipyard of the Nippon Kisen Kaisha. When purchased by the Kuhara interests it was planned to continue shipbuilding on a large scale, but the Disarmament Conference following shortly after, compelled a radical modification of this program, limiting the production of the plant to marine engines and other heavy machinery. In June 1920 the works received an order from the Imperial Railway Department for a large type locomotive, and so well did it meet with the official requirements and trial runs that other orders quickly followed and the works placed on the approved makers' list of theG overnment. The plant was incorporated with the Hitachi Engineering Works, Ltd., in 1920, under the name of the Kasato Factory. It covers 5,326 *tsubo* and employs nearly a thousand men. It specializes in the manufacture of steam and electric locomotives, bridge girders, structural steel, marine engines, railway machinery and copper castings. The normal output of the works is valued at Yen 3,000,000 annually, with a full capacity valued at Yen 4,000,000. The value of the total ordinary production of the three Hitachi plants is placed at Yen 22,000,000, with an emergency capacity of about Yen 30,000,000.

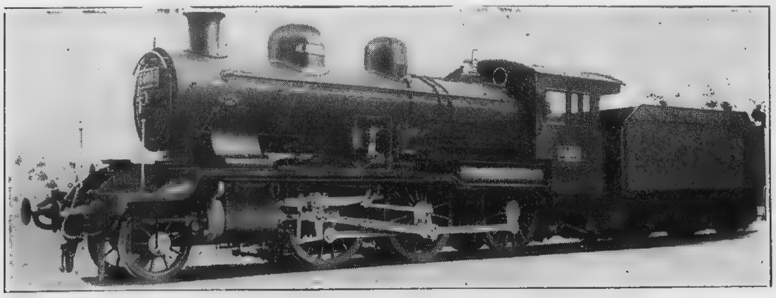
1,378 k.v.a. Hitachi Altertator, 2,588 v, 68 cycles

All of the copper used in these manufacturing plants comes from the mines of the Kuhara Mining Company, the pig-iron from China and Japan, and the other materials purchased from America or England whenever they cannot be supplied from Japanese sources. The main office of the Hitachi Engineering Works, Ltd., is in the Kuhara Building in Tokyo, under the direction of the Director-General, Mr. N. Odaira. The head of the Kasato factory is Mr. I. Furuyama. The Kameido factory is directed by Mr. S. Rokkaku and the Hitachi factory by Mr. N. Takao. Sales offices are maintained in every city of prominence in Japan and Korea.

Social Welfare Work

The Hitachi Works in Ibariki Prefecture are spread over the towns of Hitachi-machi and Takasuzu-mura, about one mile from the Sukegawa station of the Government Tokiwa railway line, five and a half hours by train from Tokyo. An electric line connects the works with the main railway stations and sidings at Sukegawa. The works are very extensive, covering an area of nearly 70,000 *tsubo*, of which 21,313 *tsubo* are occupied by the Shibauchi main factory, 18,000 by the electrical works, and 30,000 by dormitories and workmen's houses. The main factory is made up of 68 buildings, covering 10,675 *tsubo*, and the electrical buildings cover 1,677 *tsubo*. The personnel includes some 353 officials and 3,042 workmen, which with their familes make a population of nearly 8,000, requiring 1,500 dwelling-houses.

Power for operating the works is derived from the Ishioka and Natsuigawa power stations of the Kuhara Mining Plant. These power-houses have a total capacity of 11,900 k.w. and supply 1,500 k.w. to the Hitachi works. The Mining Plant also furnishes the Hitachi works with water. Many of the large Japanese industrial companies have taken the lead in social service work for their employees, expending large sums annually to better their living conditions, provide sports and amusements, hospitals, day nurseries and schools for advanced courses in industry. The welfare of the worker is as much a part of the regular budget as legitimate manufacturing expenses. The Hitachi Engineering Works have followed the same wise and beneficent policy and established special schools maintained by the company for the benefit of their workers. Boys who have graduated from grammar school are admitted to what is called the Apprentice Training School, where they are given a two year course in Morality, Japanese and English languages, Mechanical Drawing, Electrical Engineering and Manufacturing, Foundry Lractice, and Office Administration. About fifty boys a year graduate from this school under the tutorship of picked men from amongst the technica, staff. Food, quarters and clothing are provided free by the company, in addition to an allowance for spending. The dormitory is a two-storey building, with lecture halls, recitation rooms, library, bath rooms and dining hall. This school is maintained at an expense of about Yen 35,000 a year.

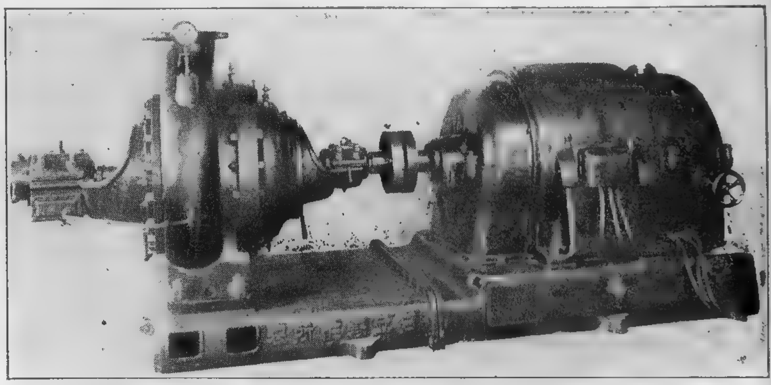


2-6-0 Locomotive for the Japanese Government Railways, made at the Kasato Factory of the Hitachi Engineering Works

From the Apprentice School the graduates have the privilege of taking up a course in higher school, where lectures are given every afternoon from 4 to 6 p.m. by the experts of the company on practically the same subjects, with the addition of Physics, Mechanical Engineering, Inspection of Materials, etc. These schools are providing the Hitachi Works with at least 50 guaduates every year who take their place in the company's widespread organization either in the factory or in the sales department. All married employees, officials or working-men, are furnished with free houses, and the bachelors with rooms in the general dormitories. Food supplies, clothing and general commodities are sold to the employees from a co-operative store at actual cost. Medical attendance and hospital treatment, theater entertainment and electric tramway transporation on the company's lines are furnished the employees without charge. As a consequence of this broad policy, the Hitachi Company is building up an organization that makes for loyalty, co-operation and freedom from labor troubles a valuable asset.

The Kameido factory is situated on the outskirts of Tokyo on the Boso Railway Line, about a half mile distant from the famous Kameido Tenjin plum-blossom district. Freight from the Hitachi Factory is unloaded at the Sumidagawa station of the Tokiwa Line and transported by lighters to the Kameido factory. When the factory was erected in 1916 the surrounding district was a marshland waste, but during the war an impetus was given to reclamation and building until now it is a well-developed district, with tramway service into Tokyo, as well as a private motor bus line connecting the factory with the Tokyo head office. The ground area of the factory is 18,471 *tsubo*, with 6,352 *tsubo* devoted to sites for 50 buildings equipped with nearly 400 pieces of machinery of different kinds. The number of employees is about 1,100. The Tokyo Electric Light Company furnishes the current for the 4,500 h.p. of electric motors operating the machinery in the factory. The water supply is derived from artesian wells on the ground. All water wheels and turbines are tested at this plant before being shipped out for erection.

The Kasato factory is located about a mile and a half from the Nejigahama and Tokuyama stations of the Sanyo Line in Yamaguchi Prefecture, on the Inland Sea. A special branch line connects the works with the main railway and the piers for the accommodation of deep-water steamers carrying cargo to or from the works. The ground area of the factory is 42,402 *tsubo*, with an additional 4,251 *tsubo* in the railway right of way connecting the factory with the main line. The dormitories and other dwelling-houses embrace 21,383 *tsubo*. There are ten factory buildings with a floor area of 5,326 *tsubo*, and 27 office buildings and store-houses covering 4,114 *tsubo*, leaving ample space for future expansion. There are 900 workmen employed at these works, with eighty in the office force and technical staff, 17 of the latter being graduates from technical colleges.



Hitachi 12-in. Two Stage Single Flow Double Suction Motor Pump delivering 300 c.m. againsta head of 450-ft. at 1,460 r.p.m: Motor 400 h.p., 2,000 v., 50 cycles. Made for the Ibaragi Coal Mine Co., Ltd.

This plant was hurriedly erected during the rush period of the Great War, and consequently little attention was paid to the buildings, but the mechanical equipment represents the very best procurable. The buildings are equipped with one 200-ton, three 100-ton and four 5-ton overhead travelling cranes and one 5-ton locomotive crane. In the blacksmith shop there are five steam hammers ranging from 800 to 2,000 lbs. and in the boiler shop is a 400-ton portable hydraulic riveter, a 100-ton hydraulic press, with drilling, grinding and sharpening machines. In all there are some 450 machines of various kinds, which, in addition to a steel casting plant, enables the factory to handle the heaviest locomotives, marine and sugar machinery. The products of the Kasato factory are now mainly locomotives and heavy industrial machinery. Electric power to the extent of 4,600 k.w. is supplied by the Sanyo Electric Company.

In addition to the Imperial Railway Department, which has placed the Kasato factory on the approved locomotive makers' list, the Works have as steady clients such important enterprises as the Tokyo Municipal Electric Bureau, operating the tramways of Tokyo; the Kure, Yokosuka, Maizuru and Sasebo Navy Yards; the Government Steel Works at Yawata; the Kawasaki, Mitsubishi and Mitsui Shipyards; the Osaka Iron Works; South Manchuria Railway; the Ieyama, Ube, Osumi, Taiyo, and Chosen Railways; several of the Formosan sugar companies, and other important enterprises.

Five-ton Cantilever Goliath Crane made by the Hitachi Engineering Works for the Mitsubishi Kobe Shipbuilding Yards

Radio Development In Japan

WITH the removal of many government restrictions imposed upon the operation of radio stations in Japan the industry has entered an entirely new stage of development during the past three months. The operation and erection of private transmitting stations over long distances has hitherto been a closed government monopoly, but with the change in the attitude of the Department of Communications, public enterprise has become interested in commercial transmission, reception and public broadcasting. This has resulted in an increase in the manufacture of radio apparatus in Japan and the growing independence of the country in the supply of material for all branches of wireless communication.

The most important development resulting from the removal of restrictions on private ownership of transmitting stations has been the formation of a new company with a capital of Y.20,000,000 which plans to improve the existing means of wireless communication with foreign countries and to build more powerful and modern stations for the extension of this service. The company, which is known as the Radio Corporation of Japan, will be a semi-government organization with a board of directors representing practically all the largest industrial interests of Japan.

Although not officially announced, it is understood that the financial interest of the government will be represented in the company through the contribution to the capital fund, of the entire plant and equipment of the Iwaki radio station and the land which had been set aside for the erection of a transmitting station for communication with Europe. The Iwaki station includes transmitting equipment of one 400 k.w. alternator and two 400 k.w. arc transmitters at Haranomachi and a receiving station at Tomioka. The antenna tower at Haranomachi is one of the most remarkable in the world. It is about six hundred feet high, one hundred and fifty feet higher than the Washington Monument, and is built of reinforced concrete under special designs of the engineers of the Department of Communications. The Iwaki station is used for direct communication with the United States and Hawaii and the company will endeavor to improve this service in co-operation with the Radio Corporation of America who control the American end of the trans-Pacific service.

The turning over of this station to the company will mean an investment of about Y.200,000 on the part of the government, which with other material will bring the total up to about Y.2,300,000. The remainder of the necessary capital will be obtained through the interests represented on the board of directors which includes such well known men as Viscount Shibusawa, Baron Goh and Dr. Takuma Dan. The importance of the company in Japanese affairs can be well understood from a list of the promotors who are in addition to the three mentioned: Baron K. Nakashima (director of Furukawa Mining Company); Mr. C. Kadono (Vice-president of Okura and Company), Mr. K. Kimura (senior director of Mitsui Gomei Kaisha); Mr. F. Kuhara (president of Kuhara Trading Company); Mr. T. Isaka (president of the Yokohama Chamber of Commerce); Mr. K. Matsukata (president of Kawasaki Dockyard Company); Dr. Y. Ono (president

Mr. Inukai, Minister of Communications, listening to the broadcasting program at the Museum attached to his department

Main Building and Antenna Towers of the New Radio Station of the Tokyo Central Meteorological Observatory

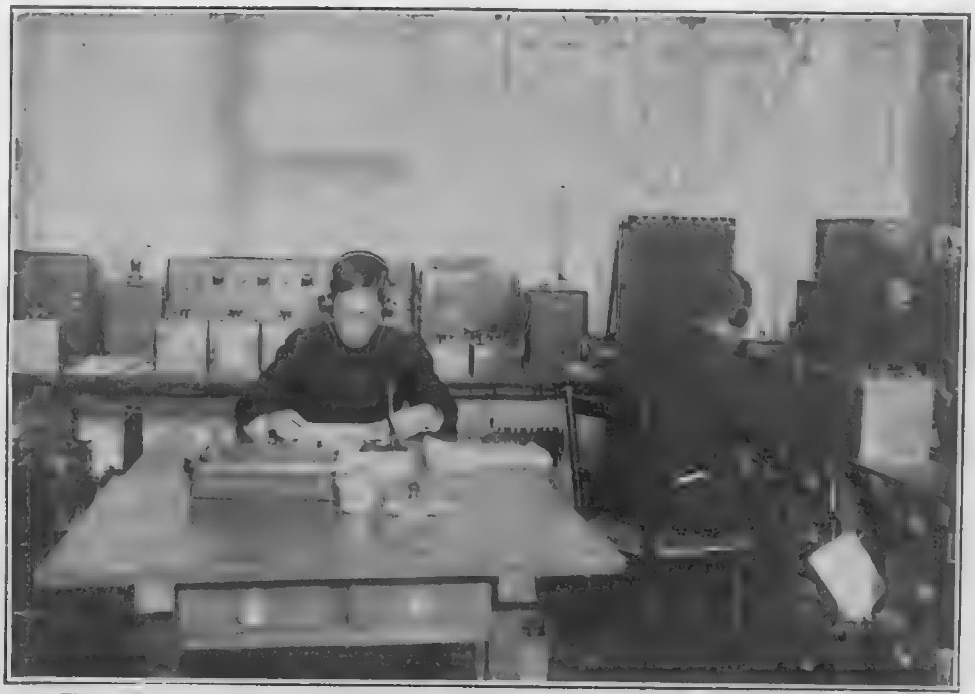


Fig. 2: Receiving equipment at the Hirano Station, near Osaka. This station is in daily touch with Nauen, Bordeaux and other European stations for the receipt of news

of the Industrial Bank of Japan); Mr. T. Yuki (Vice-president of Yasuda Bank); Mr. K. Inahata (president of the Osaka Chamber of Commerce); Mr. K. Iwahara (president of Shibaura Engineering Works); Baron Y. Togo, Mr. K. Kambe (president of Tokyo Electric Light Company); Baron H. Fujita (head of Fujita Gumi); Mr. K. Nakata (senior director of Sumitomo Goshi Kaisha); Mr. B. Konda (senior director of Toyo Kisen Kaisha); Mr. K. Hori (president of Osaka Shosen Kaisha); Mr. M. Kushida (chairman of the board of directors of Mitsubishi Bank); Mr. K. Nanjo (director of Mitsui Bussan Kaisha); Mr. K. Koike (president of Tokyo Gas Company); Mr. K. Uchida, Mr. M. Suenobi, and Mr. O. Matsukata. The erection of the long needed high-power station for duplex communication with Europe direct will be the largest undertaking of the company in the first stage of its development work. One of the prime reasons for the formation of the organization has been to obtain the necessary funds for this station and its erection will be undertaken at the first opportunity. The site of this station will be near the city of Nagoya, the transmitting equipment being at Kariya and the receiving station at Yokkaichi. Both the transmitter and receiver will be operated by remote controls at the central office in Nagoya.

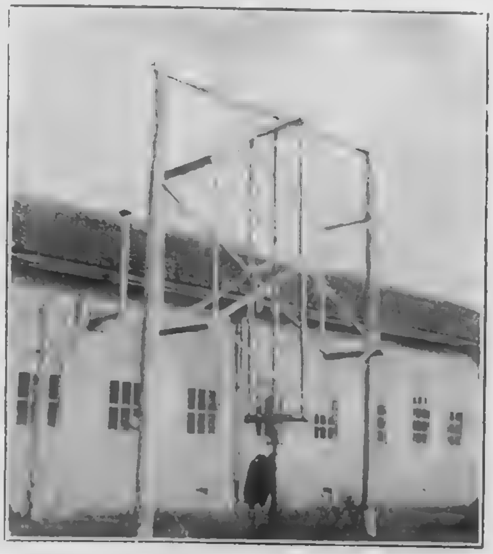


Fig. 1: The largest directional loop antenna in Japan, located at the Government's receiving station at Hirano. This antenna is used for both long and short distance work and is very selective on either wave band

The transmitter will be a high frequency generator with an antenna effect of above 120,000 meter amperes. The antenna will be of the inverted L type supported on eigth steel towers 250 meters in height. The Nagoya district is one of the greatest sources of electric power in Japan and the station is to be located there on account of the reliability and cheapness of the power which will be required to operate the station.

The wireless system of communication in Japan will then be extended to include the South Seas and additional stations for the Far Eastern division and another American station of greater power. When the plans of the company are completed, Japan will have one of the most highly developed and efficient radio systems in the world.

The actual operation of the various new stations and the Iwaki equipment will be directly under the control of the Department of Communications, who will furnish the operating and engineering personnel. Maintainence and extensions will be financed by the company but will be carried out by the government. Close co-operation with the land wire telegraphs of Japan will be kept up in order that messages may be delivered through an existing organization with the greatest efficiency.

The formation of the Radio Corporation of Japan is the result of a long series of negotiations for the establishment of a central radio system. The complete plans have been worked out for all the needs of the industry for several years in advance and with the idea of utilizing the existing installations to the fullest extent. The bill authorizing the organization easily passed both houses of the Diet during the last session and actual work has begun on the carrying out of the original plans.

The starting of public broadcasting has been another stage of development resulting

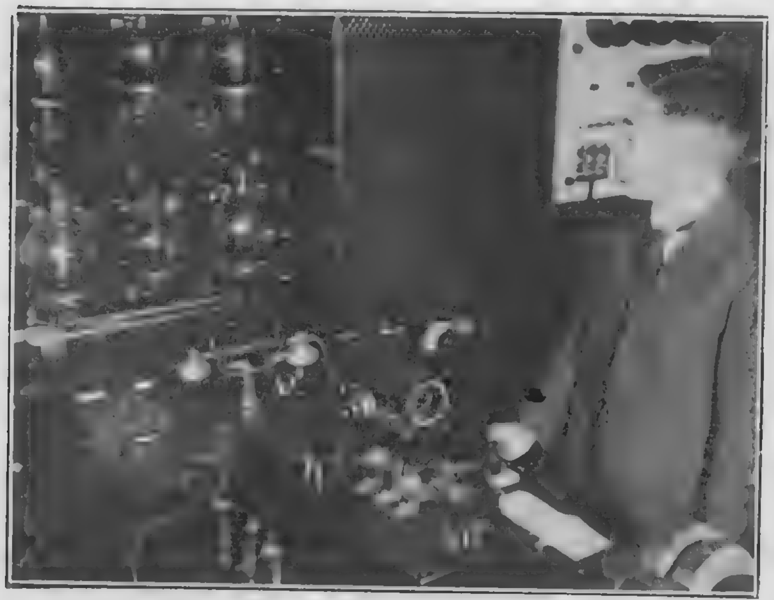


Fig. 10: Japanese made one kilowatt vacuum tube transmitter of the Tokyo Meteorological Observatory at Kanda. This station is one of the few in Japan using the Telefunken system of "feed-back" coupling

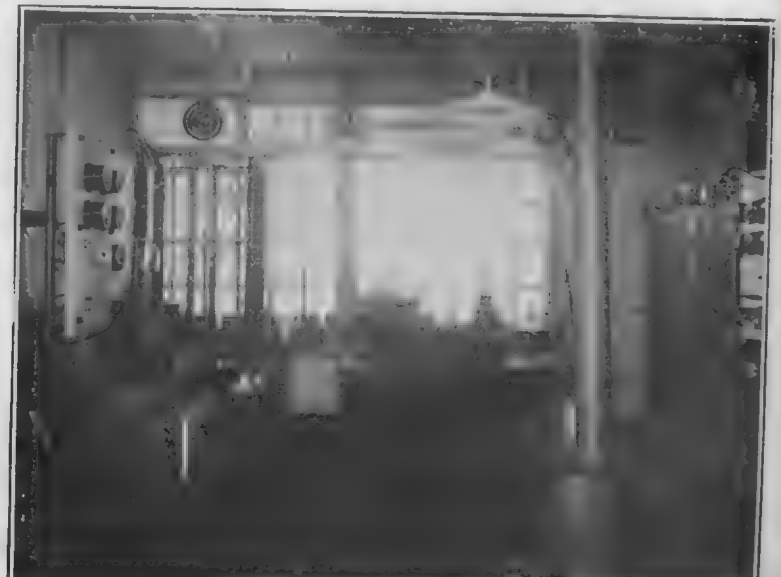


Fig. 11: Control room at the Kanda Radio Station, showing the receiving instruments in the center and the vacuum tube transmitter at the right, with the arc set to the left

from the broader policy of the government toward radio communication. Limited official sanction was given by the Department of Communications for the operation of private broadcasting stations in April, 1924, under a very restrictive set of regulations which were drafted and brought out at that time. The regulation of the broadcasting transmitters remains the same at present although changes have been made in the laws governing receiving sets.

As the regulations now stand, broadcasting stations are divided into two classes, one for short range work and the other for transmission over long distances. The smaller class of stations are limited to a wave length band of from 215 to 235 meters and an antenna power input of less than 150 watts. The range of these stations is officially set at a distance of not more than thirty kilometers.

Stations of the larger class are assigned to wave lengths between 360 and 385 meters and may have an antenna input up to one kilowatt. The districts to be served by such stations are limited to a radius of about 160 k.m., but there is no objection to receiving sets outside this range listening to the programs providing that they have a license to do so.

The department further requires that all broadcasting apparatus be constructed so as emit only a pure continuous wave with secondary waves and harmonics eliminated as far as is technically possible. The modulation of the carrier wave must also be good. There is no restriction in the natural wave length but the antenna must be erected in such a way that the wave length will not be affected by weather conditions or shifting of the wires. The aerial must be so constructed as not likely to injure men or animals in the vicinity.

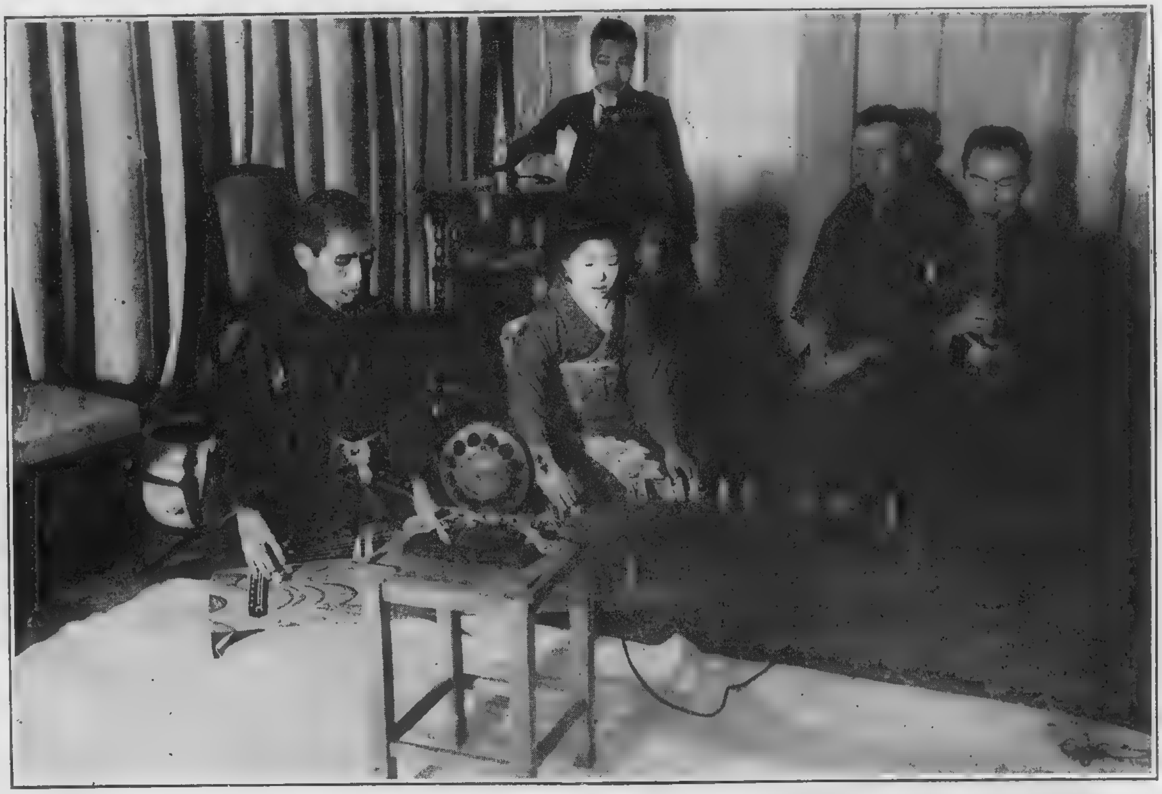


Fig. 4: The broadcasting of Japanese music over the radio has been a great success, as it has been found that it is much easier to transmit this form of music without distortion than foreign music, which has greater complexity

Broadcasting studios must be built as nearly sound proof as possible and designed with special acoustic properties so that there will be little reflection from the walls of the room to interfere with the purity of the sounds transmitted through the microphones. Noises in the transmitting apparatus from the generators or from other causes in the machine itself must be brought as low as possible.

The government charges five hundred yen a year for a license to broadcast over the long distance and three hundred yen for the smaller stations. This sum is payable in advance.

Although the regulations do not so specify, it is understood that the department will grant a license to only one large station in each district such as Tokyo-Osaka or Nagoya. This is in order that there will not be any conflict in transmitting time or interference between the various programs. Restriction of power and wave lengths and of the sharpness of wave required will also be used to combat any interference or rivally which might reduce the efficiency of the system in general.

As soon as these regulations were announced in 1924 the government was deluged by applications from all sides for permission to build stations by the newspapers and the radio manufacturing companies. Unable to grant permission to all the applicants the Communications Bureau advised that an association be formed including all those interested in broadcasting around Tokyo and that the control of one large station be given to this organization for operation and financing. Petty jealousies among the prospective members as to the controlling interest in the association delayed its formation for a time but the Tokyo Broadcasting Association (Hosokyoku) became an accomplished fact in December, 1924.

Viscount Shimpei Goto is president of the association which includes representatives of the Japanese press, the radio manufacturers, the larger electrical companies and many prominent business men of Tokyo. An operating fund of three hundred thousand yen has been raised among the members which will be used for the construction of a modern broadcasting station and running expenses until the organization is put on a paying basis, when the fund will be returned to the subscribers. The income of the association is derived from a monthly fee of two yen a month which is charged each receiving set owner in the district, the number of which has now passed the ten thousand mark in Tokyo alone.

In order that broadcasting might begin as soon as possible after the formation of the association, the City of Tokyo loaned a transmitter to the bureau for temporary use until the main equipment is constructed. This transmitter of one kilowatt was erected at Shibaura and has been in operation since the first of March. (Fig. 3). The station operates on a wave length of 385 meters and has given satisfactory results, being heard in many places in China and Korea and as far north as the Hokkaido.

The large number of members in the association which controls the station has made it possible to secure a great deal of material for broadcasting and has made the programs practical as well as entertaining. A complete report of the movements in the morning session of the Stock Exchange, the Rice Exchange and the Raw Silk Market is sent out just before noon and includes the quotations of the principal key stocks and commodities. The closing prices are broadcasted at the close of the day's market late in the afternoon. A time signal is sent out at noon which is controlled from the Tokyo Observatory. Weather reports compiled by the Meterological Observatory are broadcasted daily at 9 a.m., noon and 4 p.m. Typhoon warnings and other information of this kind which is of interest to the general public is also put on the ether at this time.

The afternoon is devoted to the broadcasting of news which is supplied by the many newspapers who are members of the association and to speeches by prominent Japanese. Professors and educators give lectures in the early part of the evening and are usually followed by the feature of the day. Many foreigners have so far spoken to the radio audiences of Japan and all express their gratification at being able to come in touch with such a large audience as is possible over the radio.

Popular entertainment numbers are sent out late in the afternoon and close the programs in the evening. (Fig. 4). These include Japanese recitations and selections from famous plays by some of the best actors, foreign music by local talent and visiting artists, and numbers of interest to children. The broadcasting station has become popular overnight in Japan and its patronage is growing by leaps and bounds.

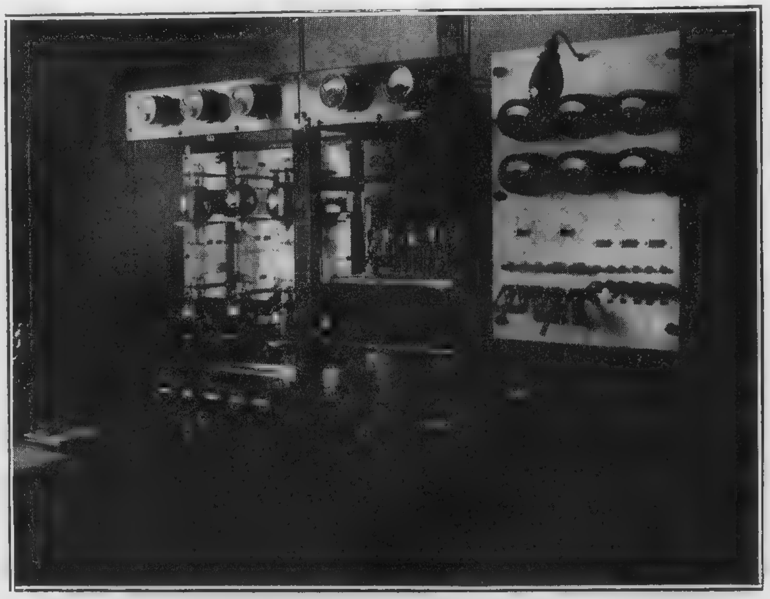


Fig. 12: Main transmitting equipment at the Tokyo Observatory Station, showing the one kilowatt vacuum tube set made by the Nippon Radio Company under Telefunken patents

The main broadcasting equipment for the permanent home of the Tokyo association has been ordered from the United States through the Western Electric Company and will soon arrive in Japan and be installed by the end of June. The apparatus consists of a vacuum tube transmitter with an input of one kilowatt and is of the most modern and efficient type which has been tried out for many years in America. A special building for the sole use of the broadcasting station is being erected on Atago Hill which commands the city of Tokyo. This building will be unique in that it is designed and built for the purpose of radio broadcasting only, it will have special studios for various kinds of programs and will be so made that spectators and visitors may watch the work of running the station without interfering in any way. The building, which is of reenforced concrete will cost over a hundred thousand yen.

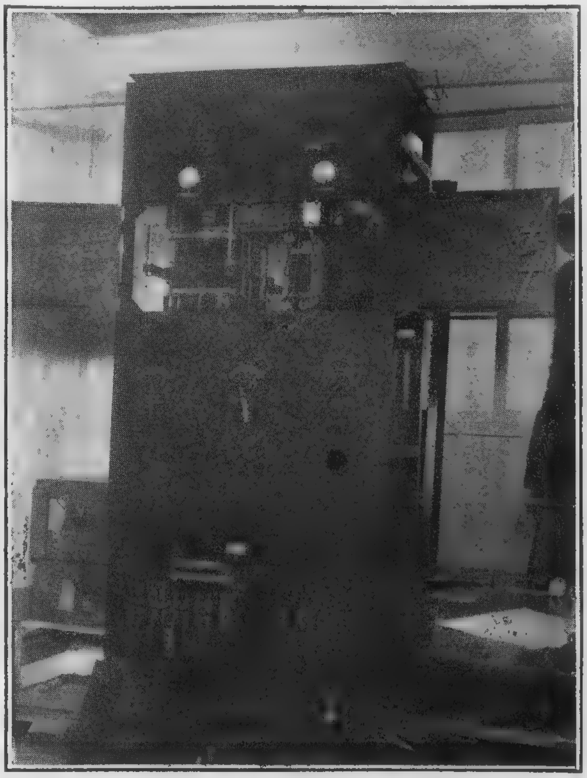


Fig. 8: One kilowatt vacuum tube transmitter made by the General Electric Company, used by the Tokyo Broadcasting Association at their new Shibaura Station

When this permanent station is opened this summer in Tokyo, Japan will have one of the finest broadcasting stations in the world. It is estimated that the programs will be heard with ease throughout Japan, Korea and parts of China, although officially the district is supposed to include only the territory immediately around Tokyo. It is planned to hold transmission tests in co-operation with American broadcasting stations in order to link the two countries by broadcasting programs arranged at special periods.

The regulation of receiving sets is also under the jurisdiction of the Department of Communications through the local offices of the bureau in the various prefectures. The rules as first drafted greatly limited the use of receivers but the latest regulations make it a very simple matter to secure a license for a receiving station.

The basic rules for receiving apparatus divide such equipment into three classes. The first class of license includes only such receivers as have passed the requirements of the government Electrical Laboratory (Denki-shi-ken-sho). This is the standard form of license and is the one which will be issued to ordinary applicants.

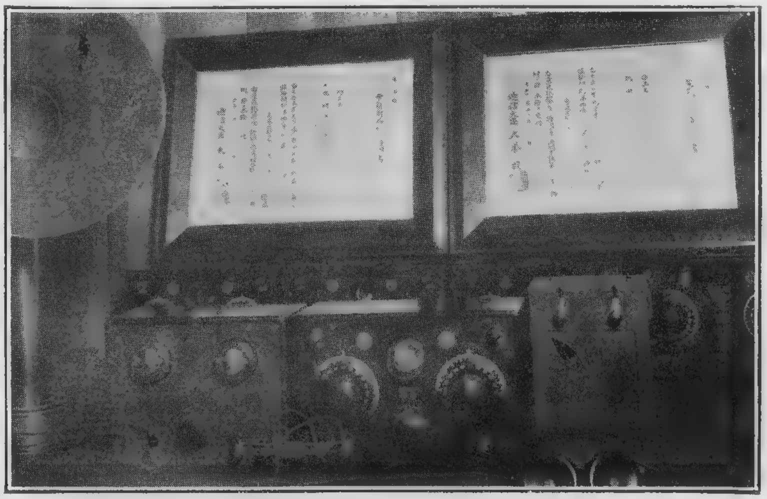
The second class license covers apparatus which has been made by an individual radio fan or manufactured apparatus which has been altered after passing through the dealers hands, all " homemade " equipment comes under this class. Holders of the first and second class licenses are restricted to a receiving wave length of not more than four hundred meters.

The third class license is issued only to applicants who desire to experiment and who can prove that they are familiar with this science. This class of license will be greatly limited, according to the Department of Communications, as the general public is not acquainted with radio receivers to an extent which would justify the granting of unlimited licenses.

Japan has had the benefit of several years of broadcasting in America and England upon which to base the present regulations and it is generally thought that they include the best points of both systems. One of the features of the laws is the prohibition of receivers which cause oscillations in the antenna circuit. This kind of apparatus has proved to be a source of great annoyance in the United States where there are a great number of sets in a limited area around the large cities. Objections to this restriction have been raised in Japan, but the industry as a whole will be greatly benefited, as it would be impossible to permit regenerative apparatus in such small territories as will be served by the central broadcasting stations without causing great trouble to the users of sets of other design.

The broadcasting system in Japan is very similar to that of Germany, with exception that the fee for broadcast the reception is paid direct to Broadcasting Company. The American system of unlimited broadcasting was not found to be possible in Japan, but many points of the American idea are to be found in the present regulations.

In the classification of receiving sets, those approved by the Electrical Laboratory come under class 1, and while it is not necessary for the manufacturer of receiving apparatus to have his material passed by this bureau, it is a distinct advantage to secure the government approval. The Electrical Laboratory has drawn up the requirements which govern its approval of apparatus in a set of regulations which are now in force, and if apparatus does not conform to this standard, the special approval of the local office of the department of Communications must be secured before such sets will be granted a license to receive.



American type of radio broadcasting receiver made in Japan by the Annaka Electric Company, This set includes a vacuum tube detector and two stages of audio frequency amplification

The Electrical Laboratory specifications require that a receiving set be so constructed that the wave length cannot be more than 400 meters. It is also required that the set be non-regenerative, although some allowances will be made in this direction in favor of sets which do not produce a great amount of oscillation in the antenna circuit. The other most important requirements are that the set shall not be so constructed that the use of the electric light circuit or telephone wires is aimed at for the antenna circuit.

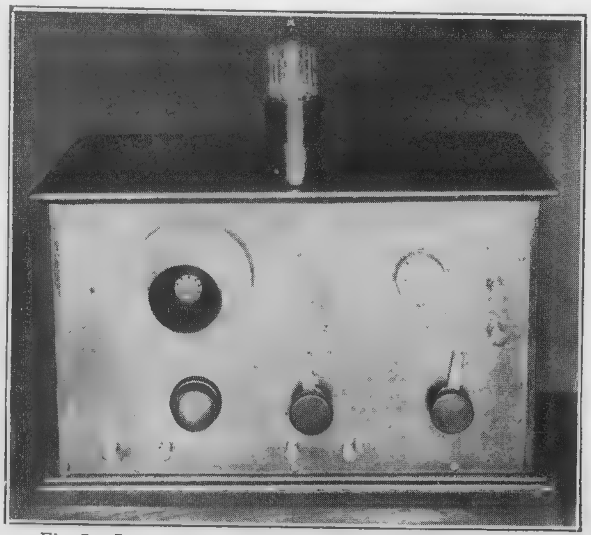


Fig. 7: Japanese five watt experimental transmitter for the use of schools and short distance transmission

The market for receiving apparatus in Japan may be divided into two classes, one in which the sale depends upon the price of the article, and the other on the quality of the instrument and the range at which it will receive. In the first class the Japanese manufacturers have a virtue monopoly on account of the protective tariff and local manufacturing. The standard price for a vacuum tube set of Japanese manufacture, including a single tube detector complete with tubes, batteries, headset and antenna and earth equipment is from 115 to 120 yen. Crystal sets cost from twenty to forty-five yen. A two stage amplifier retails for about sixty to seventy - five yen. (Fig. 6 and 7). Foreign apparatus will be unable to compete with these retail prices on a cost basis, especially sets which use foreign made tubes.

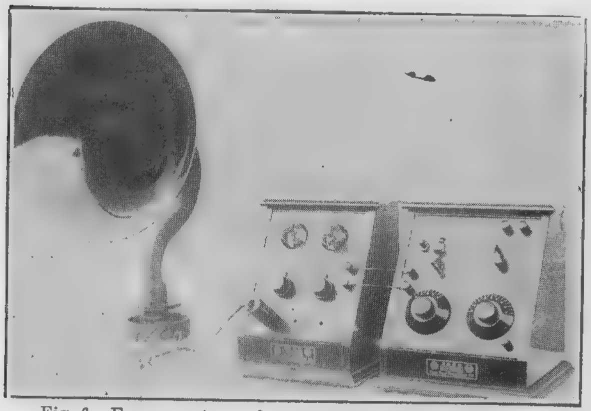


Fig. 6: European type of receiving set made in Japan for use in the reception of broadcasted programs. Crystal detector in connection with a two stage audio frequency amplifier

The field for foreign manufactured receiving sets is quite as large as that for the domestic made product and is in the receivers which will be wanted by a great many fans which will be capable of picking up all the various broadcasting stations throughout the country and in special cases, the stations at Shanghai, Hongkong and Manila. So far the Japanese have not made any sets in large numbers which will do this, while there have been a number of foreign sets of well known makers which have been quite successful in all these requirements. The market for accessories is specially open to foreign firms, and the demand includes good loudspeakers, headsets and various refinements.

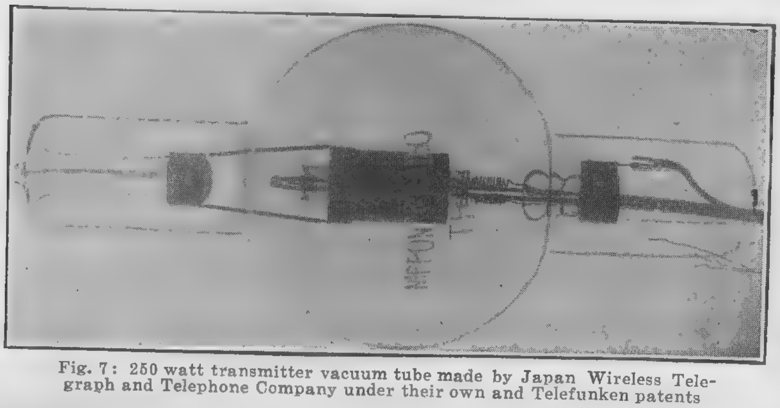


Fig. 7: 250 watt transmitter vacuum tube made by Japan Wireless Telegraph and Telephone Company under their own and Telefunken patents

The importer of radio apparatus must bear in mind that broadcasting is a comparatively new development in Japan and that the general public has not become familiar with the operation of complicated receiving sets. For this reason the apparatus should be made as foolproof and simple as possible also replacements of foreign made parts would mean a great expense and long delay for the user. If possible the set should be made for the use of Japanese vacuum tubes and batteries, as the cost of the imported material is almost prohibitive except in the case of the highest quality apparatus. Patent rights held in Japan will not permit the importation of a certain number of foreign made tubes.

Vacuum tubes are made in Japan by the Tokyo Electric Company under general electric patents and by the Nippon Radio Telephone and Telegraph Company under Telefunken patents. (Fig. 7). Other tubes are made in Japan but the patent rights are obscure and the importer who expects to use such tubes should be careful to investigate the exact standing of the material in question.

Conditions peculiar to the Japanese market also require an agent on the ground who is familiar with the territory and the special requirements of the country. With such an agent and with the kind of material outlined, the field is practically virgin territory and open to a large volume of business for a long time to come. Judging from the experience of the Tokyo Association, they will be a wave of enthusiasm for public broadcasting in Japan at least equal to the developments in England and the United States during the past two years. Osaka and Nagoya have both started experimental broadcasting and will have permanent stations within a short time.

The great increase recently in the use of radio communication generally together with the stimulation of decreased government restriction has immensely benefited the manufacture of apparatus in Japan. This industry is confined to a comparatively few firms, the largest being the Tokyo Electric Company, Shibaura Electric Works, the Nippon Electric Company, the Japan Radio Telegraph and Telephone Company and the Annaka Electric Manufacturing Company.

The Japan Radio Telegraph and Telephone Company have entered into an agreement with Siemens-Schukert whereby they manufacture apparatus under patents owned by the German Telefunken firm and have turned out considerable material under this agreement. They manufactured and erected the two modern stations owned by the Kobe Marine Observatory and the Tokyo Meterological Observatory, the first being established in Kobe in 1923. The latter station has just been completed at Kanda in Tokyo.

The Tokyo Observatory station is one of the best examples in the country of a plant manufactured throughout by a Japanese concern. (Fig. 8 and 9). The station equipment is a one kilowatt vacuum tube transmitter of the latest type for ordinary communication (Fig. 10, 11 and 12). The vacuum tube transmitter uses an exclusive Telefunken feature in what is known as the "feed-back" coupler and is also designed so as to use both tonic and ordinary sending as desired. The Observatory station is now sending out weather reports, storm and typhoon warnings and other information of interest to navigators on a regular schedule.

The Japan Radio Company specialize in the manufacture of portable sets for the Japanese Signal Corps and other Army and Navy equipment as well as vacuum tubes for receiving and transmitting, receiving sets and parts for broadcasting reception and commercial use and other kinds radio station equipment. The company maintains a staff of research engineers who are constantly working on new patents for the firm and improvements on existing system.

The Annaka Electric Manufacturing Company is one of the oldest firms engaged in the production of radio apparatus in Japan. This firm specializes in the manufacture of wired wireless sets, which are becoming a common form of communication between power stations and distributing centres. Several of these systems have been installed by the Japan Hydro-Electric Company, Tokyo Electric Company, Tokyo Electric Light Company, Kinugawa Power Company and government departments, where they are a great success and a distinct saving in the system of communication between isolated points of the power units. Annaka also manufacture vacuum tube transmitters for the railway department and are working on a system of wired wireless for use in railway signalling. The company are large manufacturers of ship station equipment and receiving sets for broadcasting use.

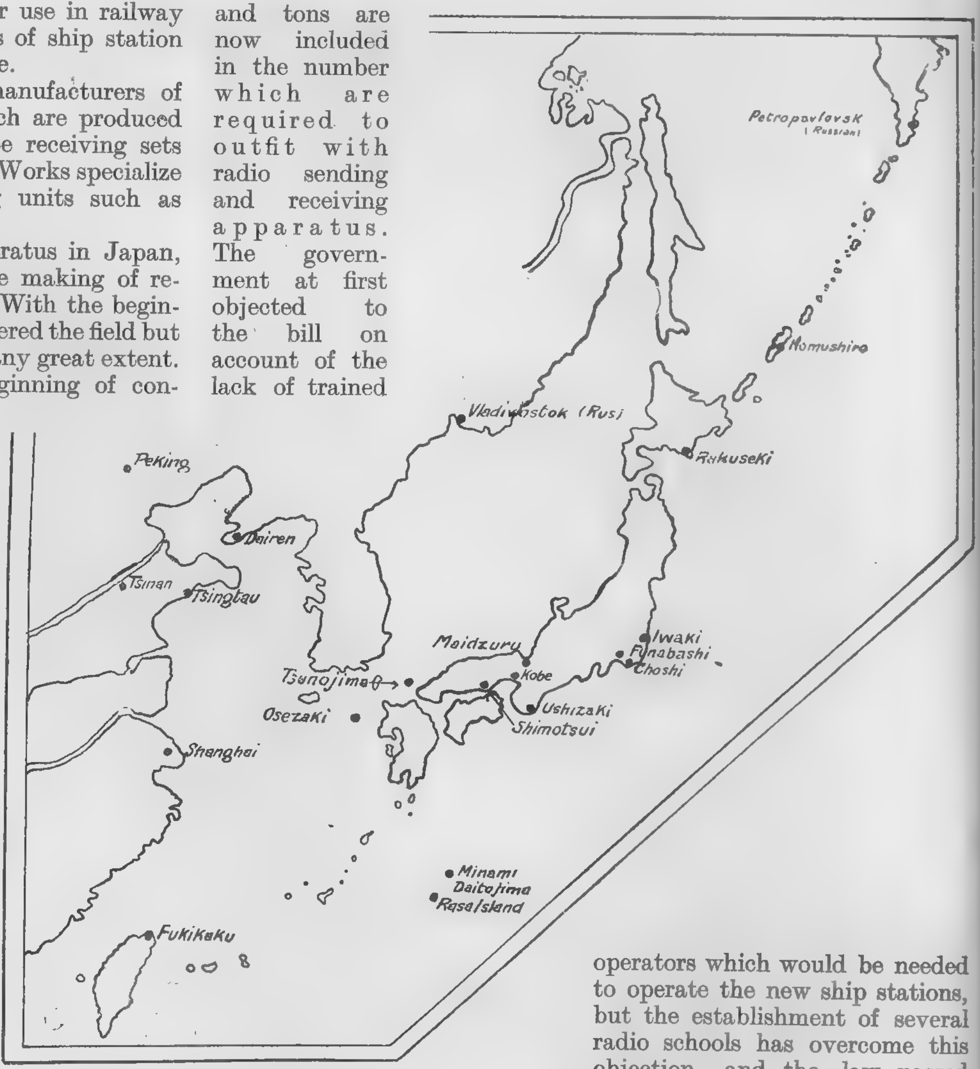
The Tokyo Electric Company are mainly manufacturers of vacuum tubes for transmitting and receiving which are produced under General Electric Patents, and vacuum tube receiving sets for the broadcasting system. The Shibaura Electric Works specialize in the manufacture of large power transmitting units such as Alexanderson alternators and transformers.

There are many other makers of radio apparatus in Japan, but their activities are confined principally to the making of receiving sets and small experimental transmitters. With the beginning of public broadcasting many new firms have entered the field but are not competing with the larger organizations to any great extent.

Other recent developments have been the beginning of construction of a sending station at Kemikawa and a receiving station at Iwatsuki, both locations being near the city of Tokyo. This new equipment will be used for direct communication with the Japanese colonies and in land stations.

The transmitters will be 50, 15, 6 and 3 k.w. vacuum tube sets. The antennas will include two of the fan type suspended on three hundred foot towers and two of the inverted L type on three 250-foot steel towers. The building of the receiving station was recently completed and the apparatus is now being installed. Recent tests of short wave communication were carried out with great success between Station 2 AC in New Zealand and the Japanese station at Iwatsuki. This station will eventually become the center of the radio network in Japan.

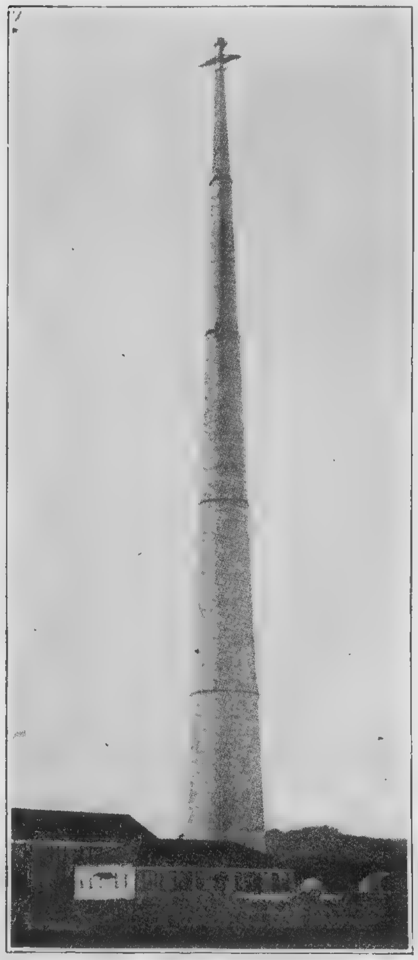
The Teishinsho also has a station at Hirano, near Osaka, through which news services have been arranged for direct reception from the German station at Nauen and the French station at Bordeaux. Hirano has four large receiving antennæ, twelve hundred feet long, on five towers, two hundred and fifty feet high.



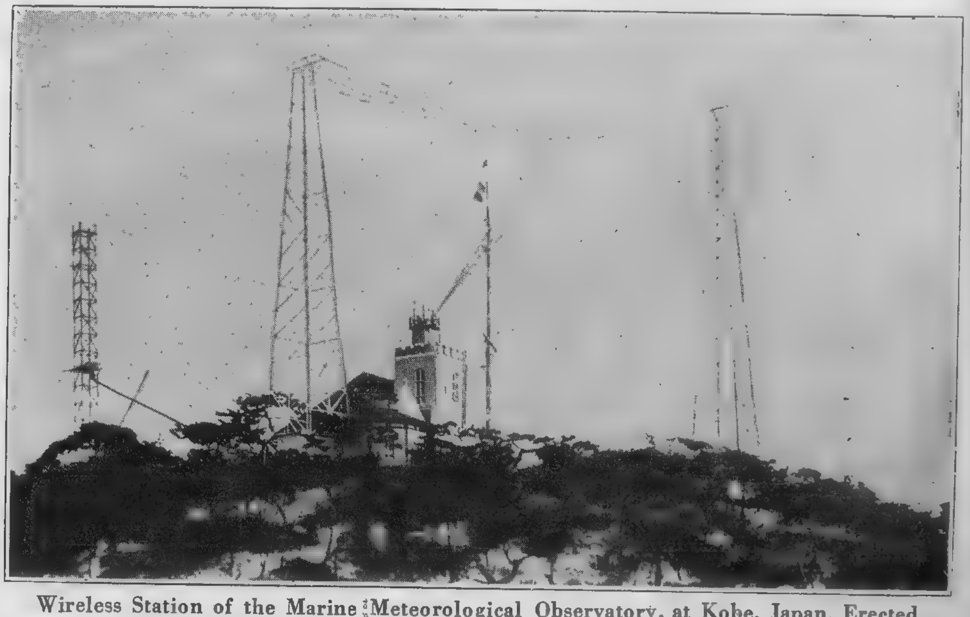
Japanese Land Radio Station

Another impetus to the radio apparatus manufacturing industry in Japan is the change which has been made in the regulations which require wireless installations on shipboard. Vessels carrying over fifty passengers and crew and ships of above two thousand tons are now included in the number which are required to outfit with radio sending and receiving apparatus. The government at first objected to the bill on account of the lack of trained operators which would be needed to operate the new ship stations, but the establishment of several radio schools has overcome this objection, and the law passed at the last session of the Diet. This will mean an immediate increase in the demand for small transmitters of below five k.w., which will probably be bought exclusively from Japanese manufacturers.

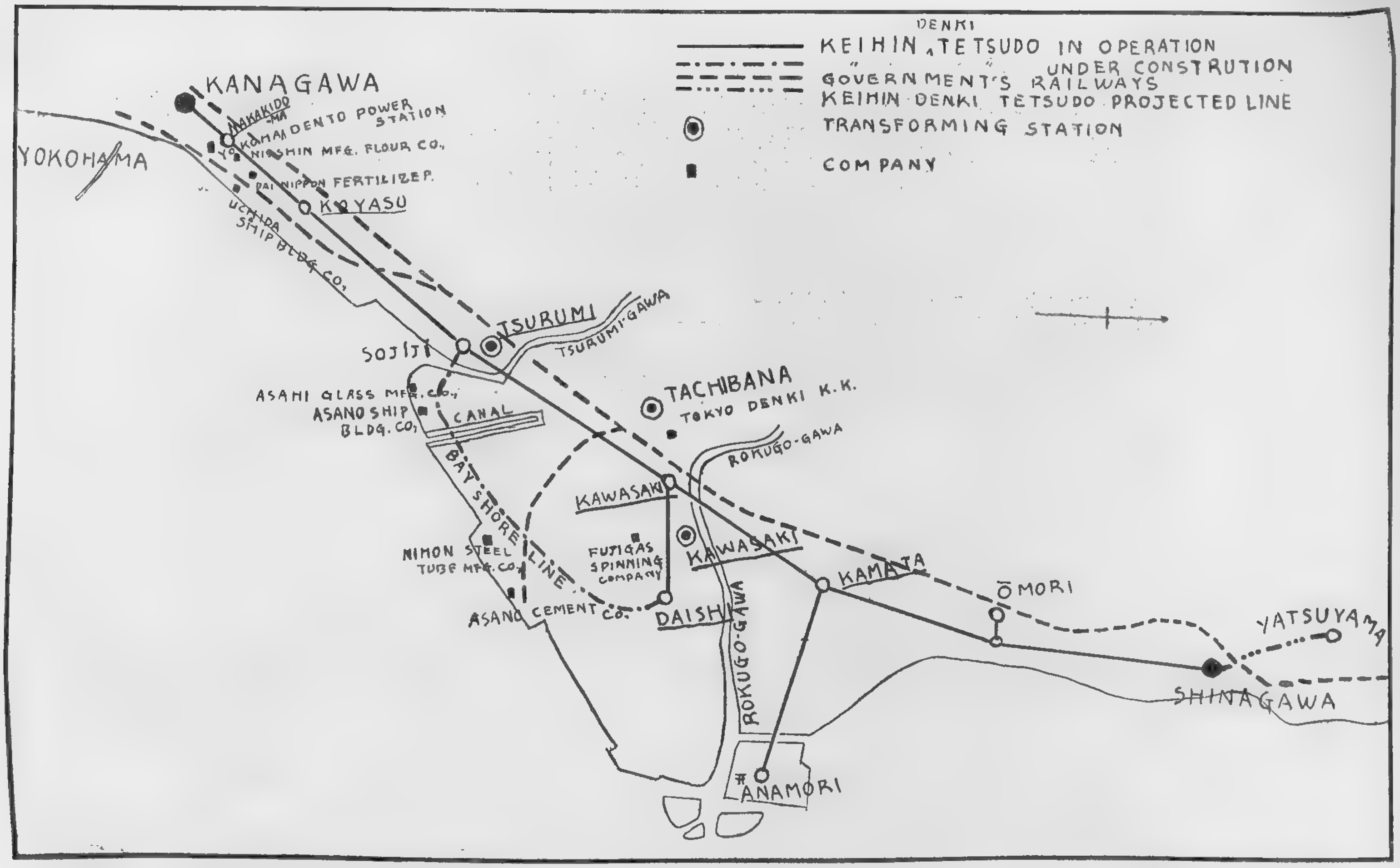
There is no doubt but what Japan has gone ahead with large strides in the development of radio communication during the past year and has outlined plans for a truly magnificent system of radio, in comparison to rather backward progress previous to 1923. With the plans which are now going forward toward execution completed, Japan will have a system of public and commercial radio stations the equal of any country in the world.



The Hara-no-Machi (Iwaki) Tower



Wireless Station of the Marine Meteorological Observatory, at Kobe, Japan. Erected and Equipped by the Nippon Musen Denshin Denwa Kabushiki Kaisha



Tokyo-Yokohama Electric Railway

The Tokyo-Yokohama (Keihin) Electric Railway

THE district between the port of Yokohama and Tokyo ten years ago was frequently described as "one long village." To-day a more apt description would be a "long industrial town." The change in Japanese life brought about by the progress made during the war period 1914-1920 (Spring) has been such that what was formerly pre-eminently an agricultural region, supplying farm products to two cities whose populations were about two and a quarter millions, is to-day a building ground for important factories whose needs are only partly served from the population of three millions which have crowded old Yokohama and Tokyo out into the country in a search for more space in which to live. Ten years ago both Tokyo and Yokohama were beginning to spread beyond their ancient boundaries.

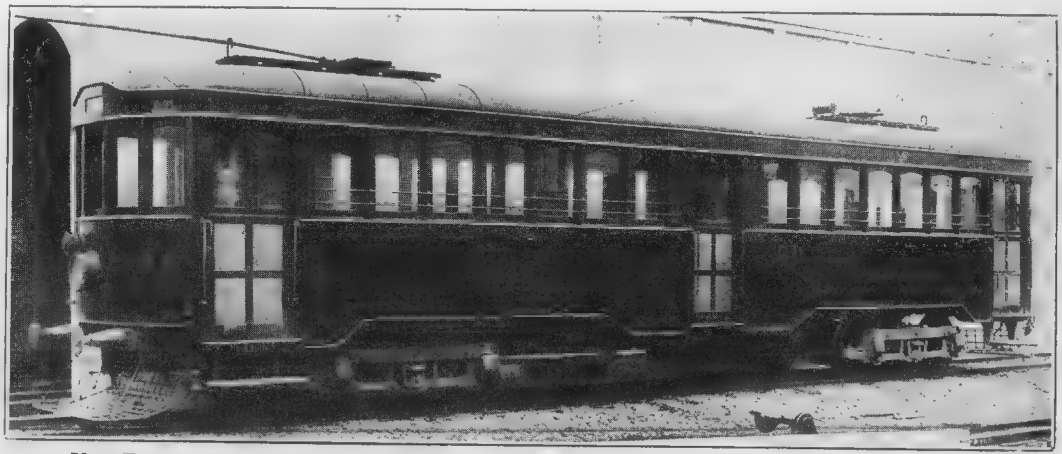
The line of least resistance was along the Tokyo Bay shore between Tokyo and Yokohama, because along that line there were :

(1) A Government railway with several stations at important centres of population between the two cities; (2) an inter-urban electric railway; (3) a national road which furnished the main artery for vehicles.

Keihin Electric Railway. Tachibana Transformer Station

Homes were slowly pushed out into the country, and when the great boom in manufacturing industries came, it was only natural that promoters should turn for building sites to localities where the population was greatest. The land between Tokyo and Yokohama also offered convenient transportation to an open port of regular call. As factories sprang up between Tokyo and Yokohama the population of the towns and villages grew by leaps and bounds, and land prices soared. This drove farmers to sell their ancestral holdings, and eventually practically all the land between Tokyo and Yokohama along the main lines of traffic was owned by factories, house builders, or by land companies.

Much of the growth of this district was primarily helped by transportation facilities. One of the most important of these is furnished by the lines of the Keihin Denki Tetsudo (Yokohama-Tokyo Electric Railway), established in 1897 to operate a short excursion line from Kawasaki Station to Rokugo Bridge, near the popular shrine called Kawasaki Daishi, a distance of 1½ miles. The Company was capitalized at Y.89,000 and was called the Daishi Denki Tetsudo. Its usefulness was unquestioned and its success immediate. It was not until January 1903 that the present



New Type of Passenger Car on the Yokohama-Tokyo Service of the Keihin Electric Railway

Kawasaki-Kanagawa (Yokohama) section was opened for commerical business, to be extended to Shinagawa (Tokyo) by the end of December 1905.

The Keihin Electric Railway Co. undertakes the supply of light and electric power in Omori, Iriarai, Oimachi, Kawasaki, Haneda, and Tsurumi.

A new line is to run between Tsurumi station on the Government railways to Daishi station on the Keihin line. The line will be built and operated under the name of another company, but the Keihin Electric Company owns all the shares. This is a common expedient, because new electric railway companies are not required to pay taxes for two years after the opening of business. After these two years have been passed it will be annexed to the Keihin. The authorized capital of the Company is Y.2,000,000, which will probably all be paid up before the amalgamation takes place. It will run through a district very well suited for factory sites, and it is the intention of this Company to build a canal to Kawasaki, cutting through the district covered by the Kaigan Kido, and with this end in view it has been buying up land on both sides of its projected canal route, and the railway line as well. This land is owned by a "Home Building Company," a subsidiary of the Electric Railway Company.

The national highway running through Kamata will greatly affect the economic growth of this district, as the road will be widened and bettered. The present line of the Keihin Railway is built on the national road for a distance of two miles between Umeyashiki and Minamizoshi. When the road is rebuilt the Keihin will change its present rail equipment to 100-lb. rails, in place of the 61-lb. rails now in use. The change will cost Y.280,000, it is estimated.

A great amount of money will be required to complete the projected canal which is to open the district between Kawasaki and Tsurumi to the sea through a port at Kawasaki on Tokyo Bay. Running south from Kawasaki Station, the Asano Shipbuilding Yards and the other Asano enterprises at Tsurumi have built an accommodation line generally known as the Asano freight line. Along the bay shore south of this line, and to the east of the Keihin line, great efforts are now being made to boost the land for use as factory and home sites. The projected canal from Kawasaki will run from Haccho Nawate along the main line of the Keihin Railway through Noda Mura, and along the Ushioda seashore, past the Asano Steel Works. It will be 8,100 feet long and 120 feet wide. Each bank will be 72 feet wide and especially built up for factory sites. The building work will give the Company some 260,000 *tsubo* of land along the canal which can be sold at a profit over and above all costs of original purchase and construction. In June 1919 it was decided to invest Y.2,300,000 in this scheme.

In June 1920 Y.1,230,000, in December Y.1,420,000, and in 1921 another Y.1,770,000 was expended, the original appropriation having proved insufficient. It was estimated that building the banks and the canal would cost about Y.10 a *tsubo* of land obtained from the construction work. The Company is finishing a new line between Omori seashore, passing through Morigasaki to Anamori, and thence to Daishi, Kawasaki. From Daishi to Tsurumi the newly-planned Kaigan Kido will connect up this whole territory. The districts traversed by this line are densely populated around Omori, but in other places not so well developed. There are no factories in this district, and it is hoped to keep them out, so this territory ought to prove attractive to prospective home builders. Morigasaki is a very fine place. This scheme plans for residential districts between Omori and Daishi, with the factory district south of Daishi extending to Tsurumi.

To complete the connection of the line from Anamori to Daishi it is necessary to bridge the Rokugo river. As the line is now built it is necessary to go to the main line, which has a bridge across this river, for through connections. The main line bridge when built cost only Y.260,000, but to build the one needed by the new line will cost, it is estimated, about Y.2,000.000. However, Rokugo river is now being banked up, and along the embankments factories will be built. If the factory belt is realized, then the expense of the bridge can be met from the increased earning the Company's line will make by serving it.

With respect to the operation of this railway after the earthquake, the system was not badly damaged, so that service was resumed within one week. Increase and extension of the Company's service later made it necessary to add twenty new cars to the rolling stock equipment. These cars are each equipped with four General Electric 263-A motors, maintaining a schedule of 42 minutes between terminals.

The new Yokohama-Tokyo highway lies, for a large part of its length, nearer to the line of the Keihin Electric Railway than that of the Government Railway, so that in the future it is quite possible that the business of the former company will increase, due to building up along the line of this highway.

Tokyo Electric Loan

Negotiations have been concluded for the flotation of debentures in the United States by the Tokyo Electric Light Company with the Guaranty Trust Company of New York. The negotiations were effected through Sale, Frazar & Company, who acted as agents for the Tokyo Electric Light Company.

The debentures to be floated total $20,000,000, with the issue price $98.50 for $100 face value. The debentures bear a 6 per cent. interest rate, with the term of redemption fixed at three years. The Electric Light Company offers no security for this debenture, unelik those secured by the Daido Electric Power Company from Dillon, Read & Company, of New York, and also by the Ujikawa Electric Company from Lee Higginson & Company, also of New York.

Mr. Walker, Vice-president of the Guaranty Trust, had been visiting in Tokyo during the past several months in connection with loan negotiations with both the Tokyo Electric Light Company and the Toho Electric Power Company. Shortly after his return to New York, in June, formal announcement of the second Toho debenture issue was made through the Guaranty Trust.

While he was in Tokyo Mr. Walker made a close survey of the property of the Tokyo Electric Light Company, which claims to be the largest business corporation under Japanese management, with the sole exception of the South Manchuria Railway. It is supposed that he determined then that no other security was necessary.

Most of this fund will be devoted to the extension of business of the company, and the rest to the conversion of old debentures which are to mature shortly.

At first the company contemplated the floating of loans in London, but with England's reluctance to send specie abroad the negotiations were dropped.

In connection with the proposed extension work it is said part of the money will be used for the Shinanogawa Hydro-Electric Company, a subsidiary organization. Upon the merger with the Keihin Electric Power Company next fall, the Light Company will increase its capitalization to Y. 300,000,000, it is reported.

Operator Pushes Buttons; Elevator Does the Rest

Buildings Equipped With Automatic Elevators Arouse the Wonder of Passengers

"IT is absolutely human!" is the comment of persons who have inspected a recently-developed Automatic Elevator, which is the latest type of high-speed intensive-service passenger elevator put on the market.

At a slight motion of the operator's hand on a lever at his side, the car gate and the landing doors close, and as if by magic the elevator starts up without any other apparent motion on his part. A tablet on the side of the car has two rows of buttons, bearing numbers corresponding to the floors.

As the passenger steps in and calls out his "six," „ eight," "ten," or "twelve," the operator presses the button bearing the corresponding number. Wondrously the car stops and the doors open—the operator has not stirred a muscle. The passenger steps out, the doors close automatically, and the steel cage resumes its upward journey until it reaches the next floor for which a button has been pressed.

Elevators in the Chiyoda Building, Tokyo

So it continues merrily on its way until its round trip has been completed, unless an intending passenger outside of the car has registered his desire to have it stop. In this case, too, as if with human understanding, the car stops and takes on its passenger and resumes its course. No flash of lights notifies the operator that a passenger is waiting. The car halts, apparently of its own accord, quickly opens its doors, closes them again with equal rapidity, and, without the loss of a second, once more starts in motion.

Micro-Drive Elevator in the Imperial Government Railway Club, Tokyo

There is no shooting several feet beyond the landing, no waste of time in leveling the elevator with the landing, nor is the impatient man who signals the approaching car forgotten and left to kick his heels until an obliging operator chooses to pick him up. His pressure of the button, indicating his desire to enter an ascending or descending car, instantly registers his call on the controller and the elevator stops automatically without any action on the part of the operator; in fact, without his knowledge.

These elevators, which are built by the Otis Elevator Company, are equipped with what is known as "signal control" and with the "micro-drive," or self-leveling feature, combined with "multi-voltage control." The entire operation of the elevators, as far as stopping at floors is concerned, is accomplished automatically by the elevator controller, irrespective of the operator of the car. The car starts when he closes the gate and stops automatically at the first of the floors for which a button has been pressed.

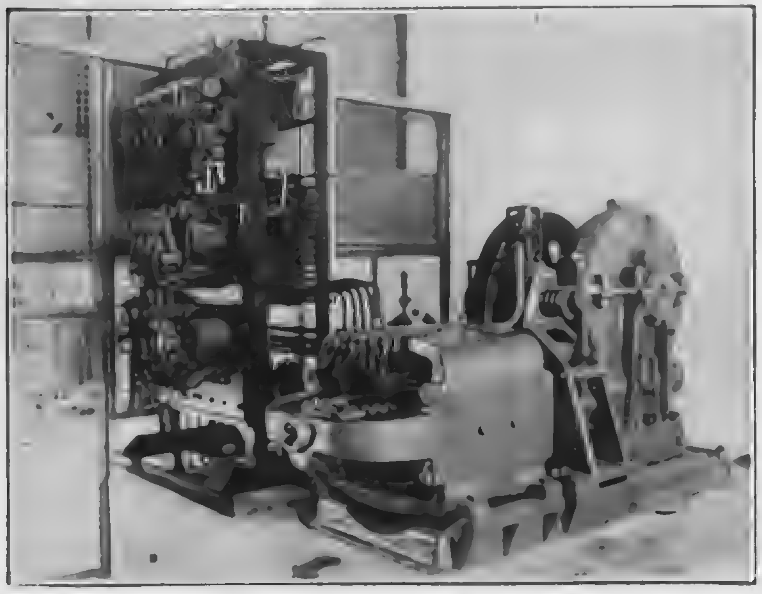
As the elevator reaches the micro-zone the main operation is automatically cut off; the micro-drive brings the car exactly to the floor level, and the doors are opened automatically. Thus "inching," or starting and stopping two or three times to make an exact landing, which causes so much delay in the operation of elevators, is avoided. This type of control, the micro-drive feature, and the multi-voltage operation, produce the greatest possible speed, and the cars are accelerated and decelerated with a degree of speed calculated not to disturb the comfort of passengers.

This improvement in elevator service is another example of the strides made in the elevator industry. Whenever it becomes feasible to increase the size of business structures or build new ones the elevator problem has already been solved, thus providing suitable transportation for buildings of any size with safety, comfort and speed.

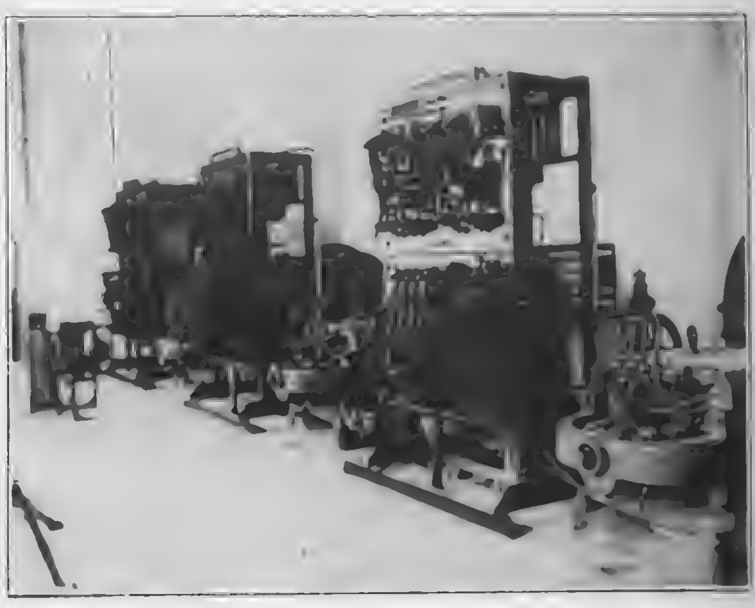
The most important factor in the erection of buildings is that of adequate and suitable means of vertical transportation, which occupies the attention of the elevator engineer in the same way that the president of a railroad studies the problem of rail transportation. Reduction of the round-trip time is one solution of this problem. There is no insuperable mechanical or safety reason why any limitation should be placed on velocity, and many elevator experts see no reason why any arbitrary limit should be placed on speed. In fact, elevators having the signal control device described above have been run in trial tests at a speed of 1,100-ft. per minute with perfect comfort and safety to passengers.

It takes time for a thought to make its way from the mind of an operator to his hand. And, too, his memory is not always accurate. Hence the automatically operated elevator. Experiment has shown that no stops can be made accurately by car switch at high speeds. Stops must be automatic, and so the time consumed by false stops made at ordinary velocities with manual car switch operation is eliminated. Such false stops ordinarily exceed 50 per cent. of the normal stops.

The next time-saver is the matter of opening and closing doors. Again the human element is removed. The operation, which when performed by hand took at least four or five seconds,

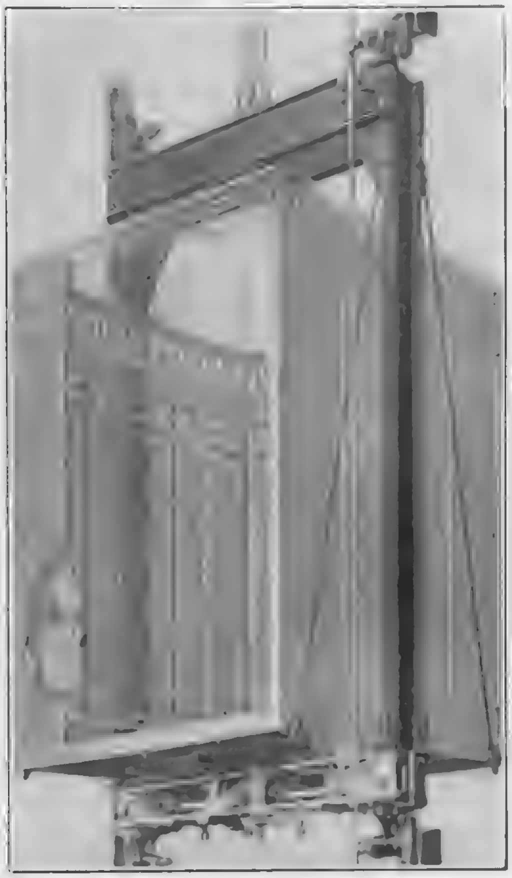


Modern Elevator Machine and Controller



Typical Elevator Machine Installation

Micro-Drive Elevator Installation with Multi-Voltage Control



Typical Elevator Frame and Car

has been reduced to two seconds for the "opening and closing cycle." Gates and doors are interlocked with the car operation and the levelling devices so that the gates and doors are operated automatically, and fully open when the car reaches the landing.

The elevator cannot leave the landing until both are closed, and locked. More than 80 per cent. of accidents to passengers arise from the fact that elevators are not equipped with car gates and interlocks.

No elevators of the signal control type have been installed in Japan, but there is no reason why the new buildings to be erected in the Tokyo district may not use this up-to-date system. Certain features involved therein are, however, at present used on some elevator installations in this district, particularly the micro-drive feature. This may be seen on the Otis elevators in the Imperial Railway Club in Marunouchi and in the Sankyo Drug Company building on the Ginza. Others are in operation in the Mitsukoshi Department Store, and several more are now being installed. Of these latter, two will utilize the unit multi-voltage system, by means of which alternating current power generates direct current for the elevator motors, and results in unparalleled smoothness in starting and stopping.

Included in the same installation is complete automatically operated door equipment, as described in a previous paragraph. As further indicative of the way in which this company considers the interests of its patrons, four escalators are being installed, each capable of handling four thousand persons per hour, and several more are now under consideration. An escalator of this same capacity is installed in the new Ginza building in Tokyo, designed by the prominent Japanese architect, Dr. Kida, seven floors of which are occupied by the Matsuya Department Store. This building is also equipped with modern American elevators and enclosure fronts of the highest quality, as are many other large buildings in the Tokyo district.

The best is none too good for the new Tokyo. It is to be hoped that as the plans for the reconstructed city materialize the elevator equipment, enclosure fronts, and other architectural features in connection therewith, as well as the buildings themselves, will keep pace with the most modern methods used elsewhere; and judging by the past, it is believed that enterprising Japanese architects and engineers will be satisfied with nothing else.

Large Turbine for Japan

ANOTHER 35,000 k.w. turbine-generator, the third so far this year, has been ordered by the Toho Electric Power Company of Japan from the International Electric Company. The last is for installation in the Nagoya station and duplicates the one ordered last year, giving that station a capacity of 70,000 k.w. The rating is 35,000 k.w. (43,750 kva., 80 per cent. per ft.), 11,000 volt, 3-phase, 60-cycle, 17-stage.

The stator will be shipped minus punchings. These, together with the windings, will be assembled at the destination. This same procedure was carried out with each of the other three units. Also, as in the case of the other three, a General Electric surface cooler has been ordered.

The two generators ordered earlier this year are for the Tokyo Electric Power Company, a subsidiary of the Toho Company, and will be installed at Tsurumi. They have similar ratings, except that they are for 50-cycle generation. The order was received by the I.G.E. Co. through Mitsui & Co., Tokyo.

MITSUI

(*Continued from page 505*).

or three new concerns projected by influential financiers with l offices in Osaka. The Mitsui Trust has as chairman of the d the director-general of all the Mitsui enterprises, Dr. Takuma , the president being Mr. Umekichi Yoneyama, one of the most ılar and gifted financiers in Japan.

The Mitsui Mining Co., Ltd.

It would require a special article to do justice to the many vities of the Mitsui Mining Company, that branch of the Mitsui vities that has made the trade-mark of the family known ughout the metallurgical world as the stamp of quality on many lucts. The Miike coal mines at Omuta, in Kyushu, with the ndid Miike coal harbor for the rapid loading of steamers, is one he most interesting and important engineering developments in continent of Asia. Starting with the mining of coal and the sub- ıent building of a modern harbor, the Mitsui transformed this er of Kyushu into an up-to-date industrial center. The Miike l Refinery, the Miike Dye Works, the Miike Iron Works, the e Coal Mines and the Miike Harbor Office, all great enterprises, located at this point and operated under one general super- on. On the same island are located the Tagawa, Yamano and Kushikino coal mines. The Yumoto mine in Fukushima, the nioka mine in Gifu, the Sunagawa mine in Hokkaido and the vakami mine in Karafuto (Saghalien) are also owned and operat- y the Mitsui Mining Company.

Rebuilding after the earthquake created an enormous demand zinc plate, much of which was being imported from abroad. Miike Refinery, however, came into the market with a large ply of the best quality plate and materially helped to keep down adverse trade balance. This refinery, established in September 4, smelts the zinc ores from the Mitsui Kamioka mine, in addition mported ores, and is capable of producing annually 13,000 tons inc, 1,000 tons of zinc white and 30,000 tons of sulphuric acid. Kamioka mine, one of the oldest silver, lead and zinc deposits apan, came into possession of the the Mitsuis in 1888.

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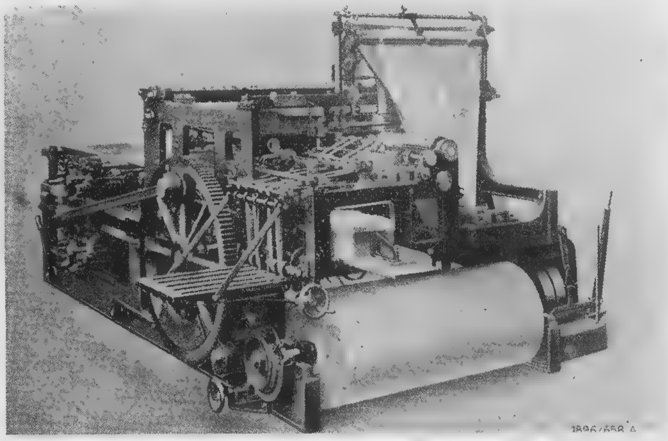

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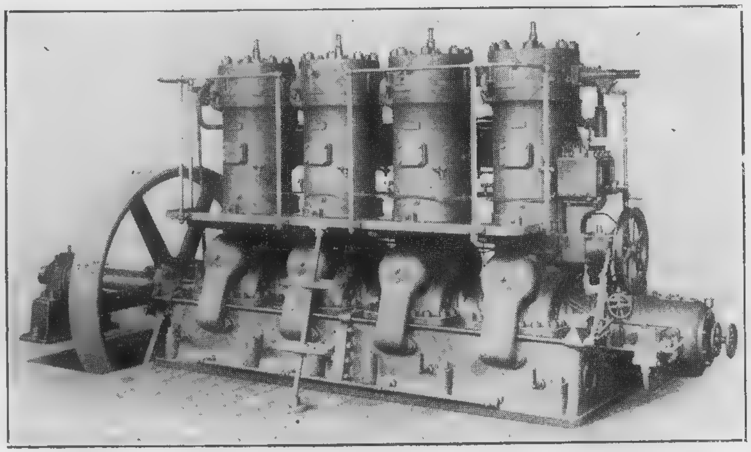

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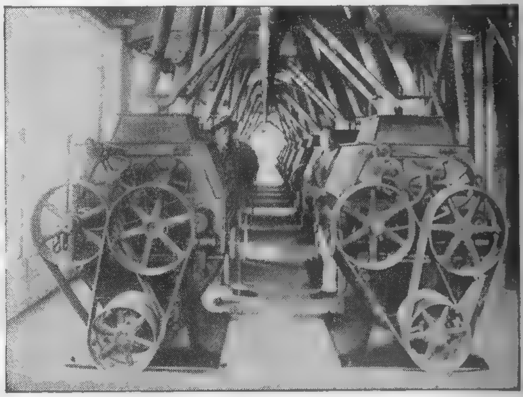

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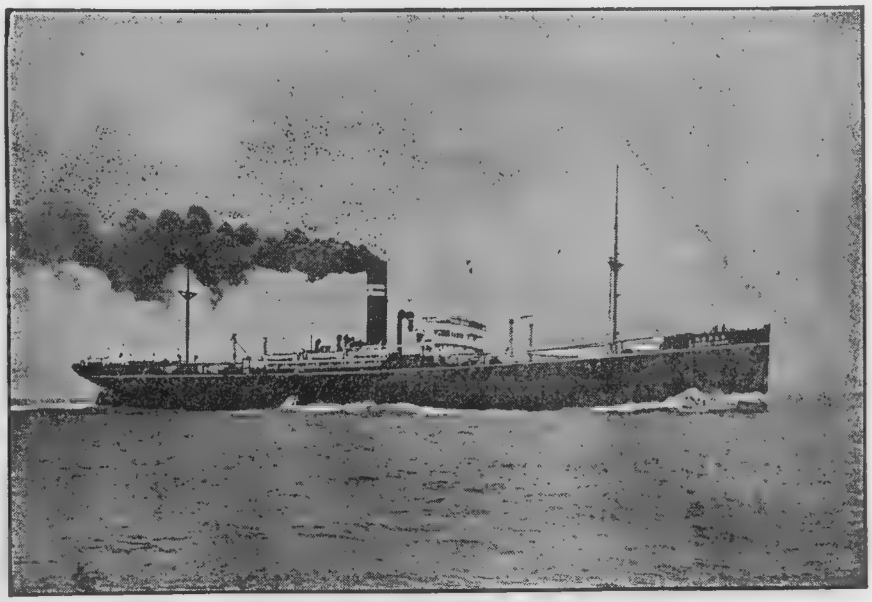

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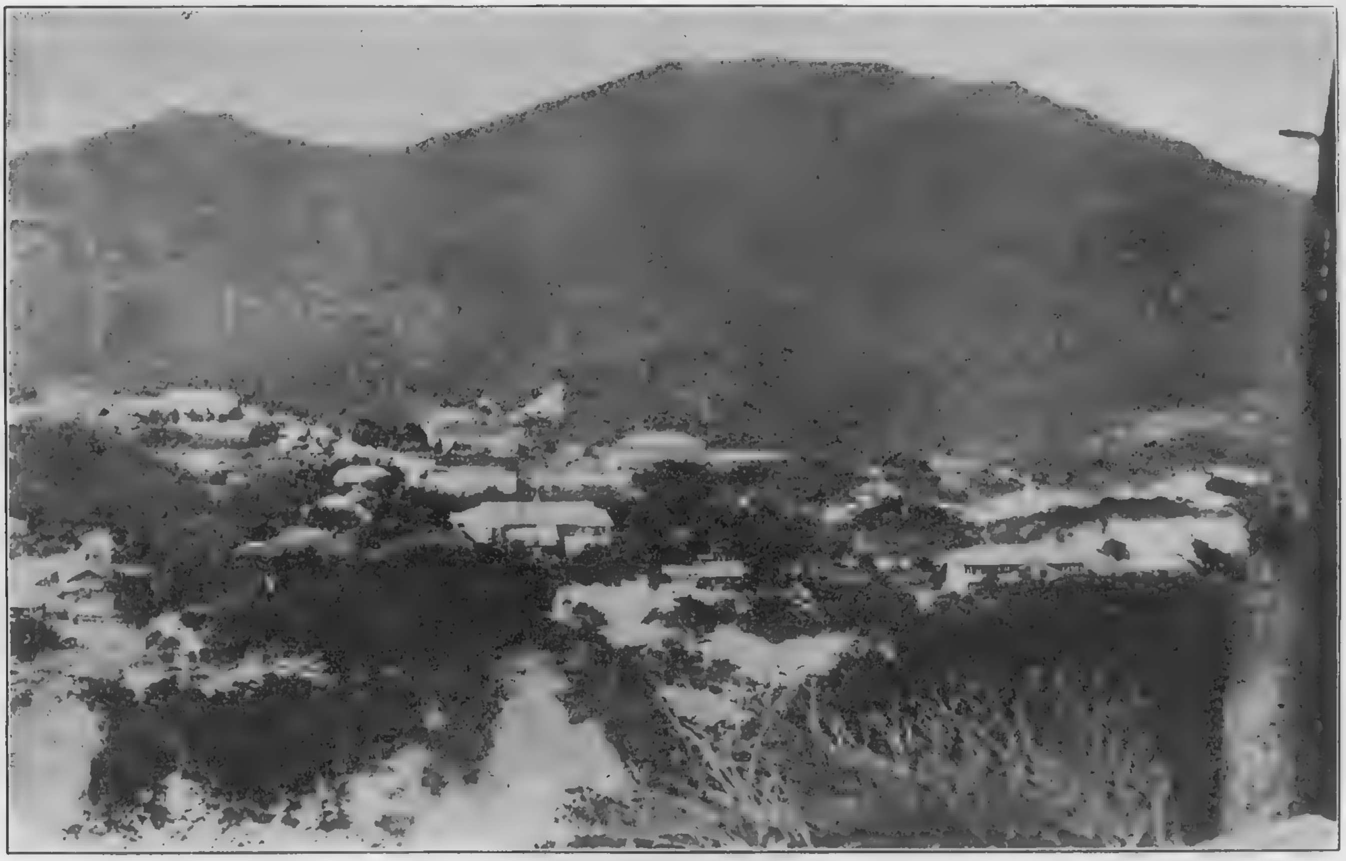

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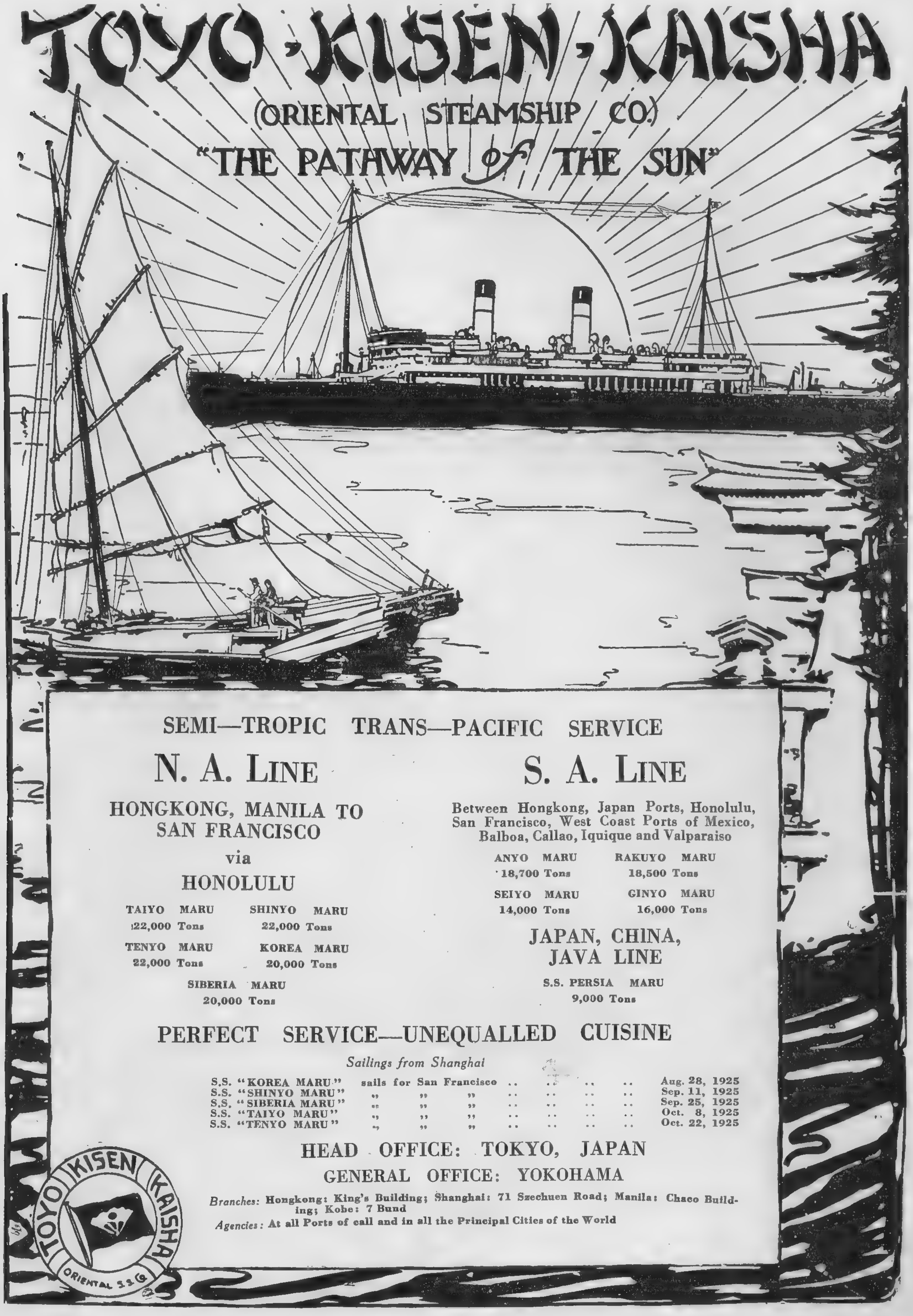

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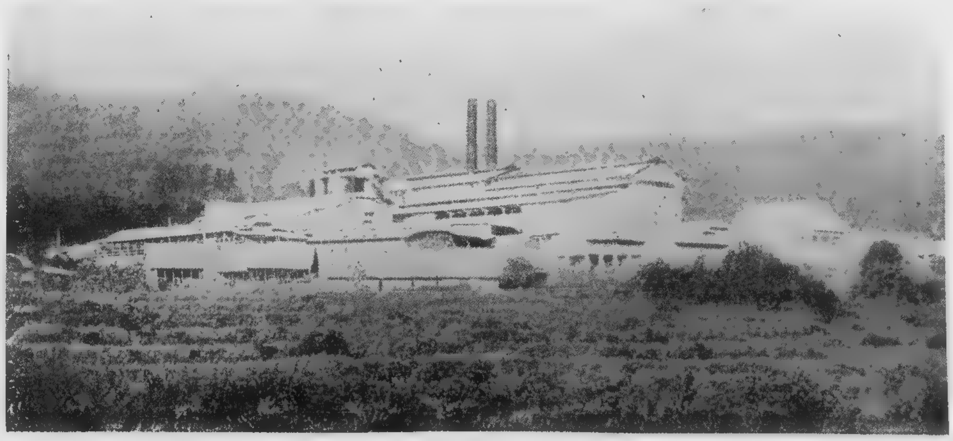

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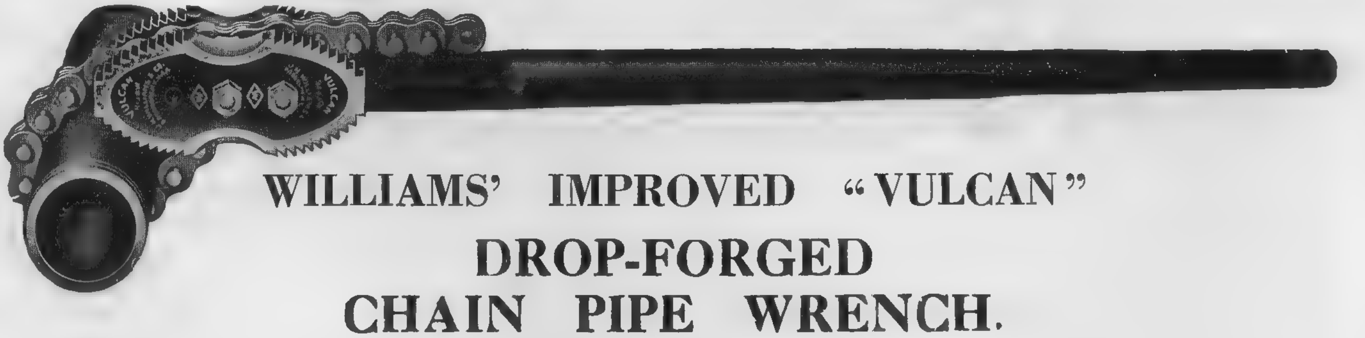

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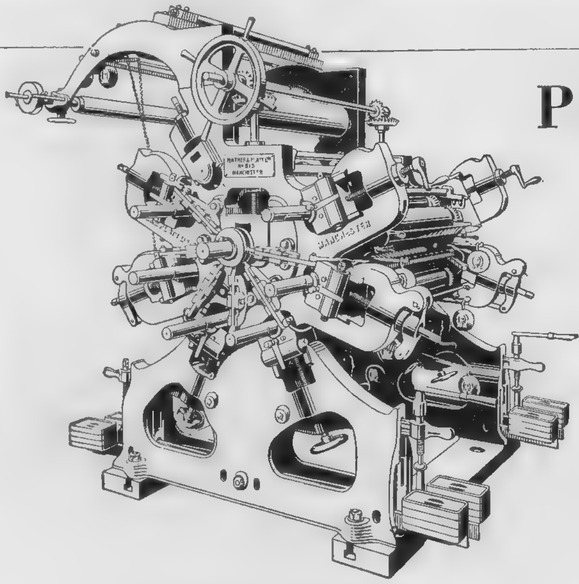

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In this department our manufacture include a full range of machines printing from one to fourteen colours; duplex machines for printing both sides of the cloth simultaneously are also made, up to the largest sizes.

Special arrangement of levers and nip fittings are a feature of our design, of which we shall be pleased to give detailed descriptions.

We have unique designs of machines for printing Sarrees and for Sample Printing, etc. Our Patent Rubber Bowls and Suction Scrapers may be fitted; these entirely dispense with the use of blankets and washing machines.

In addition to the Printing Machines themselves, we make every requisite for the Complete Equipment of Print Works. Our Representative will be pleased to give you fullest information.

Mather & Platt Ltd

For 100 years—Makers of Textile Machinery
PARK WORKS, MANCHESTER — and at
14, Great Smith Street, LONDON, S.W.1., ENGLAND

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HONGKONG & WHAMPOA DOCK CO.

LIMITED,

HONGKONG

BUILDERS AND REPAIRERS OF SHIPS AND ENGINES OF ALL KINDS

and Makers of

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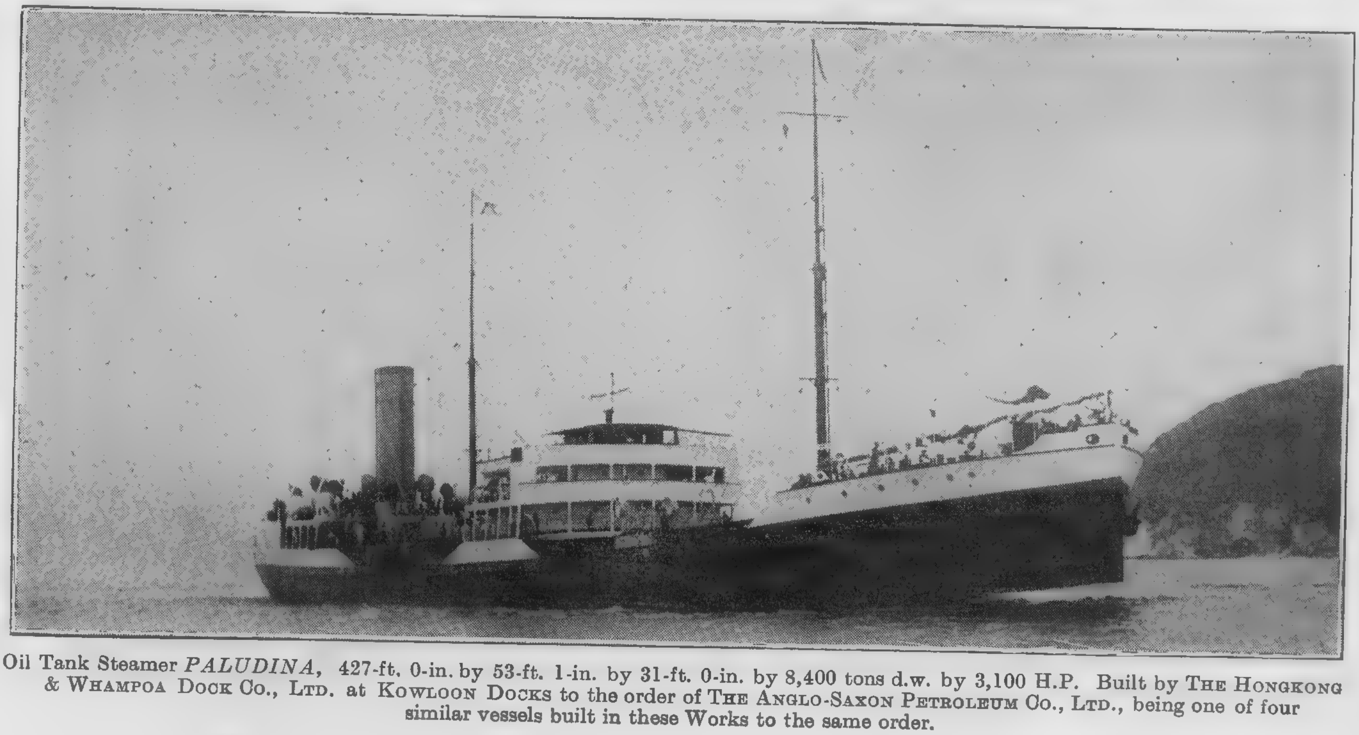
Dock Owners, Ship Builders, Marine and Land Engineers, Boiler Makers, Iron and Brass Founders, Forge Masters, Electricians

The Company possesses Six Granite Docks and Two Patent Slipways and these are Equipped for Expeditious Work. The Plant is of the most modern type throughout. Ship Owners and Captains are assured that Docking and Repairs are carried out Promptly and at Moderate Charges.



Oil Tank Steamer *PALUDINA*, 427-ft. 0-in. by 53-ft. 1-in. by 31-ft. 0-in. by 8,400 tons d.w. by 3,100 H.P. Built by THE HONGKONG & WHAMPOA DOCK CO., LTD. at KOWLOON DOCKS to the order of THE ANGLO-SAXON PETROLEUM CO., LTD., being one of four similar vessels built in these Works to the same order.

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		Breadth of Entrance	Depth of water on Sill
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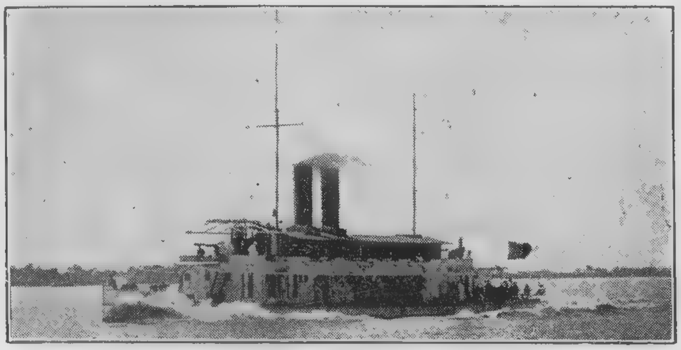
International Dock ...	528 ,,	77 ,,	23 ,,
Old Dock	399 ,,	53 ,,	16 ,,
Tunkadoo Dock ...	350 ,,	67 ,,	16 ,,



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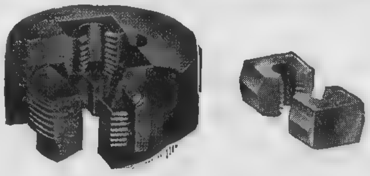
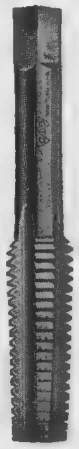
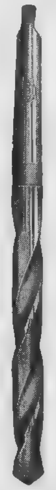


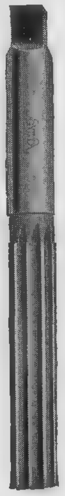
Little Giant Collet and Die



Tap



Drill



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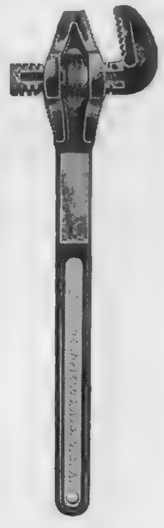
Little Giant Pipe Die Jet

Pipe Cutter



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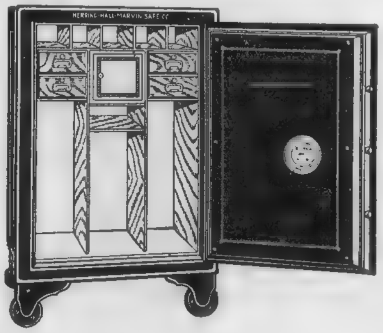

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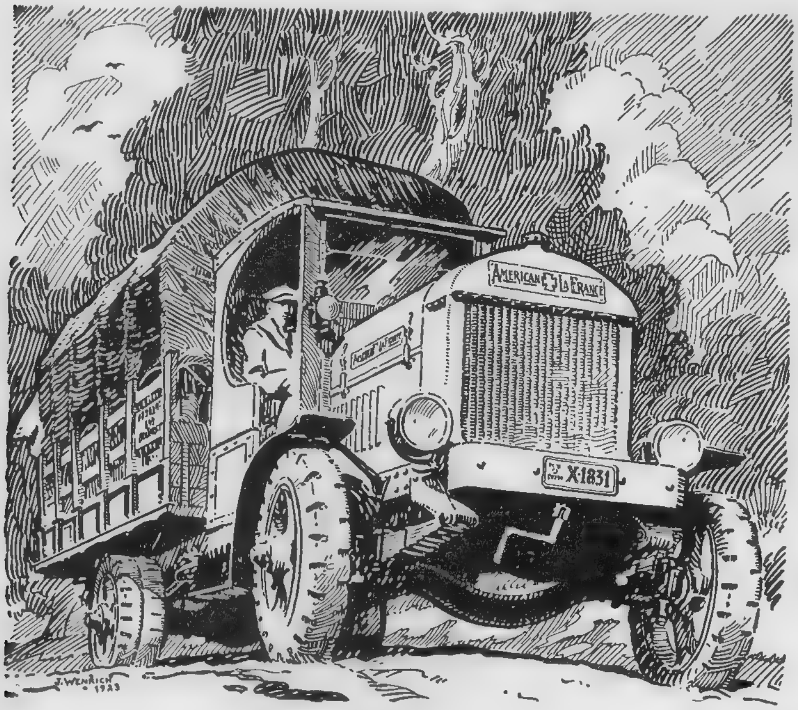

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World's Largest Fire Apparatus Manufacturers

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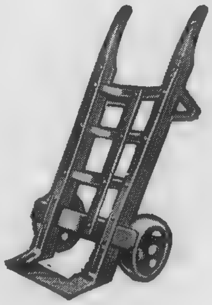
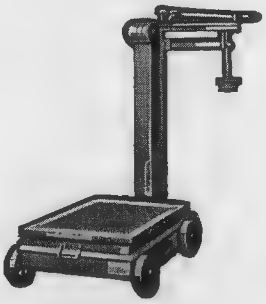
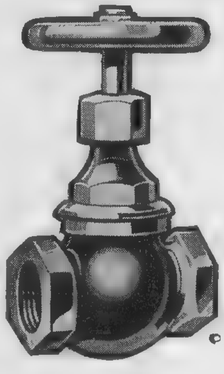
SCALES, VALVES, TRUCKS AND BARROWS







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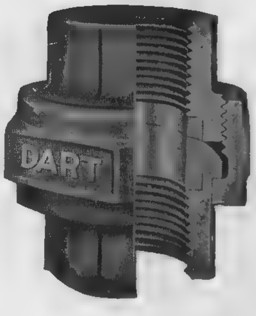

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GENERAL MANAGERS, HONGKONG

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Directors :
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Telegrams: "Jugo Tokyo"

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LIMITED

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5.—Discounting of bills.
6.—Foreign exchange business.
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	Issued and fully paid up	$20,000,000
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	Silver...	$26,500,000
	Reserve Liability of Proprietors	$20,000,000

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SUNGEI PATANI
TIENTSIN
TOKYO
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Interest allowed on Current Accounts and on Fixed Deposits according to arrangement.

Local Bills Discounted. Credits granted on approved Securities and every description of Banking and Exchange business transacted. Drafts granted on London and the chief commercial places in Europe, India, Australia, Africa, China, Japan and America.

G. H. STITT, *Manager.*

THE ONE HUNDREDTH BANK, LTD.

(DAI HYAKU GINKO)

ESTABLISHED 1878

HEAD OFFICE: TOKYO, JAPAN

CAPITAL	Yen 25,000,000.00
RESERVE FUND AND UNDIVIDED PROFIT	Yen 10,935,821.00

KUNIZO HARA, Esq., *President*

Branches: Yokohama, Kobe, Kyoto, Osaka and 13 Others
Agents and Correspondents: More than 3,000 at Home and Abroad

Exceptional Facilities Offered to Banks and Bankers in China and her Adjacent Countries for Banking and Exchange Business

CORRESPONDENCE INVITED

SEND YOUR BUSINESS TO US

THE SUMITOMO GOSHI-KAISHA

OSAKA, JAPAN

OWNERS OF BESSHI COPPER MINE, COAL MINES, SILVER AND GOLD MINES, ETC.

Manufacturers of : Tubes, Plates, Sheets and Bars of Copper, Brass, Bronze and other Alloys, Solid and Drawn Steel Tubes, etc.—Superphosphate and Composite, Manure, Sulphuric and Nitric Acid, etc.

WORKS AND DEPARTMENTS

Mining Offices	Besshi, Wakamatsu, Sapporo & Ohgayu
WORKS:	
Copper Works	Osaka
Fertilizer Works	Niihama
Sales Departments	Osaka, Tokyo, Yokosuka, Nagoya, Kobe, Kure, Hakata and Shanghai
Forestry Department	Osaka.

The Sumitomo Steel Works, Limited

OSAKA, JAPAN

Capital Subscribed : Yen 12,000,000

Manufacturers of : Steel Ingots, Steel Forgings, Steel and Iron Castings of Every Description for Railways, Shipbuilding Yards Mines, Hydraulic Electric and Other Engineering Works, etc., etc.

The Sumitomo Electric Wire & Cable Works, Limited

OSAKA, JAPAN

Capital Subscribed : Yen 10,000,000

Manufacturers of : Copper, Brass, Bronze and Nickel Wires and Strips, Trolley Wires, Insulated Wires and Cable of Every Description for Telephone, Telegraph, Lighting, Power Transmission, etc., etc.

THE SUMITOMO WAREHOUSE CO., LTD.

Capital Subscribed: Yen 15,000,000

Head Office: Osaka, Japan Branches: Osaka, Kobe & Tokyo

Warehousing, Forwarding, Landing, Shipping and Dock Business, Stevedores and Custom Brokers

THE SUMITOMO BANK, LTD.

KITAHAMA, OSAKA, JAPAN

Subscribed Capital	Yen 70,000,000
Paid-up Capital	Yen 50,000,000
Reserve & Surplus Funds	Yen 24,430,000
Deposits	Yen 400,000,000

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Baron K. SUMITOMO	President
K. YUKAWA	Managing Director
S. YOSHIDA	,, ,,
N. YATSUSHIRO	,, ,,
K. NAKADA	Director
K. HORI	Director
T. KANOH	,,
S. IMAMURA	,,
D. KAWADA	,,

Home Branches: Tokyo (15), Yokohama, Nagoya, Kyoto (2), Osaka (12), Kobe (3), Onomichi, Niihama, Kure, Hiroshima (3), Yanai, Shimonoseki, Moji, Kokura, Wakamatsu, Hakata and Kurume.

Foreign Branches: London, New York, San Francisco, Los Angeles, Bombay, Shanghai and Hankow.

Affiliated Banks: The Sumitomo Bank of Seattle, Seattle. The Sumitomo Bank of California, Sacramento, Cal. The Sumitomo Bank of Hawaii, Limited, Honolulu.

Bankers: Lloyds Bank, Ltd., London. The National City Bank of New York, New York. Lloyds and National Provincial Foreign Bank, Ltd., Paris.

Correspondents: In all important places at home and abroad.

The Bank buys, sells and receives for collection Drafts and Telegraphic Transfers; issues Commercial and Travellers' Letters of Credit available in all important parts of the World, and acts as Trustee for Mortgage Bond, besides doing General Banking Business.

"The Land of Opportunity!"

CANADA, with its wealth of undeveloped natural resources, offers greater opportunities than any other country.

To the farmer, Canada offers a future of increasing prosperity; to the workman, fair wages and working conditions; to the business man, every chance for trade and expansion.

The Royal Bank of Canada

Head Office:
MONTREAL.

London Office:
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THE EXCHANGE BANK OF CHINA

Registered in the Ministry of Finance, 1918

Capital..	**Yen 10,000,000.00**
Reserve Funds and Balance Brought Forward to Next Account ..	**Yen 2,667,000.00**

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Managing Director	W. Kobayashi, Esq.

PEKING BRANCH:

Chief Manager	K. C. Lee, Esq.
Sub-Manager	S. Uyeda, Esq.

TIENTSIN BRANCH:

Manager	Shieh Ling, Esq.,
Sub-Manager	R. Tonegawa, Esq.

SHANGHAI BRANCH: 5 Foochow Road, Shanghai.

TELEGRAPHIC ADDRESS "KNABEX"

Manager	K. H. Lin, Esq.,
Sub-Manager	H. Yokoyama, Esq.

Foreign and Domestic Exchange and General Banking Business of Every Description Transacted.

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Domestic Agencies at Shanghai, Tientsin, Hankow, Tsingtao, Dairen, Changchun, Mukden, Foochow, Amoy, Swatow, Hongkong, Canton, Tsinan, Antung, Harbin.

THE BANK OF TAIWAN, LTD.

Established 1899

TAIPEH, FORMOSA (TAIWAN)

Tokyo Branch:

No. 1 Nichome, Eiraku-cho, Kojimachi-ku

Telegraphic Address: TAIWANGINK

Telephones:

3421, 4539, 4540, 5617, 5618 & 2326 Ushigome

Capital Subscribed	Y. 60,000,000
Capital (Paid-up)	Y. 52,500,000
Reserve Fund	Y. 14,180,000

President :

Kojuro Nakagawa, Esq.

Vice-President :

Hirozo Mori, Esq.

Directors :

Gunji Kawasaki, Esq.
Tadasu Hisamune, Esq.
Denkichi Takita, Esq.
Masakazu Shuto, Esq.

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Taiwan:	Keelung, Tainan, Takow, and 11 others.
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In the principal cities and towns throughout the world. Every description of Exchange and General Banking business transacted. Special facilities are available for exchange business on China, Strait Settlements, East Indies, Australia, Great Britain, America, Canada, South Africa, etc.

THE DAI-ICHI GINKO, LTD.

(FORMERLY THE FIRST NATIONAL BANK)
ESTABLISHED 1873

Capital (Paid Up) - - -	Yen 50,000,000.00
Reserve Funds - - - -	Yen 44,800,000.00

Y. SASAKI, *President*
K. ISHII, *Managing Director.* Y. NOGUCHI, *Managing Director.* S. SUGITA, *Managing Director.*

HEAD OFFICE:
No. 1 KABUTO-CHO, NIHONBASHI-KU, TOKYO.
T. AKASHI, *Manager*

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MUROMACHI, SHIN-OSAKACHO, FUKAGAWA, MARUNOUCHI, KYOBASHI, ASAKUSA.

HOME BRANCHES:
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SEOUL, FUSAN.

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The Bank, in addition to its own Branches, has numerous Agencies or Correspondents in the principal Cities and Towns at Home and Abroad.

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(ESTABLISHED 1863)

CAPITAL SUBSCRIBED - - - -	Yen 150,000,000
CAPITAL PAID-UP - - - - - -	,, 92,750,000
RESERVE FUNDS - - - - - -	,, 48,650,000
DEPOSITS - - - - - - - - -	,, 572,514,504

Head Office: Nichome, Eiraku-cho, Marunouchi, Tokyo, Japan

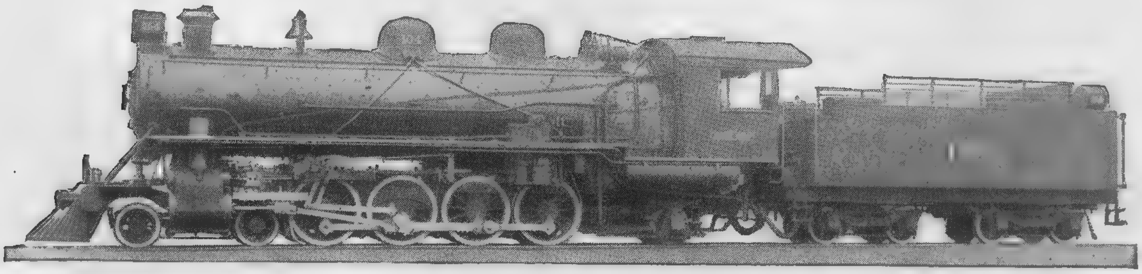
President	ZENJIRO YASUDA
Vice-President	TOYOTARO YUKI
Managing Director	TEIZABURO TAKEUCHI
,, ,, ...	HISASHI HYOSU

The Yasuda Bank has Branches or Agents throughout Japan and in all the principal parts of the world.

Cable Transfers, Drafts, and Letters of Credit issued; the Negotiation and Collection of Bills of Exchange and other Banking Business transacted. Offers exceptional facilities for handling transactions in the Far East.

BALDWIN

THREE-CYLINDER LOCOMOTIVES



Built for Paulista Railway Company, Brazil

Gauge, 3-ft. 3⅜-in.
3 Cylinders, 17-in. by 22-in.
Working pressure, 202-lb.
Driving Wheels, diameter, 48-in.
Weight, total engine, 171,500-lb.
Weight, engine and tender, 268,300-lb.
Tractive force, 34,100-lb.
Ratio of adhesion, 3.4

WE have recently completed four Three-Cylinder locomotives of the Mountain (4-8-2) type, as illustrated above, for the Paulista Railway of Brazil.

Three-Cylinder locomotives have certain advantages over the ordinary Two-Cylinder type, including the following:—

Greater tractive force within the same limits of weight and clearance.
More even turning moment throughout a revolution.
Increased horse-power per ton of locomotive weight.
Lighter reciprocating parts and better balance, with a consequent decrease in the dynamic augment.
Improved draft on the fire because of six exhausts per revolution instead of four, permitting the use of larger exhause nozzles and consequently reduced back pressure on the piston.

The Three-Cylinder design can be applied to practically all the usual wheel arrangements of the modern locomotive.

We will prepare designs to meet any conditions of service. Full information upon request.

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THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA, U.S.A.
1400 [illegible] *Cable Address*: **"Baldwin, Philadelphia"**

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THE WORLD'S GAZE

TURNS

POLITICALLY, ECONOMICALLY, ARTISTICALLY

TOWARDS

JAPAN

WHERE

Oriental charms are jealously preserved intact amidst the most advanced Oriental civilization

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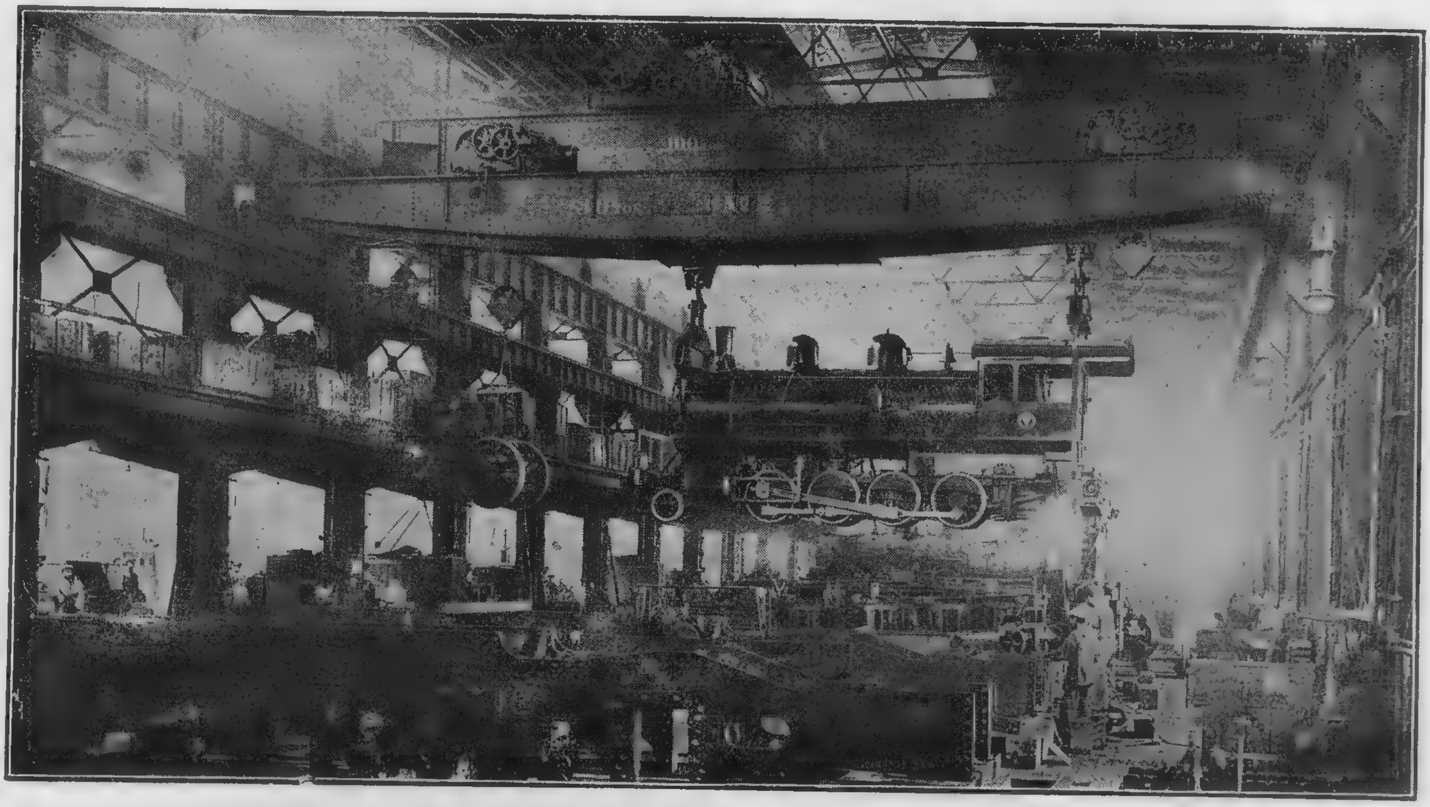
Traffic Bureau, Department of Railways

TOKYO, JAPAN

SOUTH MANCHURIA RAILWAY

SHAKAKO RAILWAY WORKSHOPS



Interior of Engine Erecting Shop, Shakako Shops, S.M.R.

LARGEST AND MOST COMPLETE IN ALL MANCHURIA AND CHINA

AREA OF LAND: About 300,000 Tsubo. OFFICES & WORKSHOPS, 14,000 Tsubo

CAPACITY OF EXECUTING REPAIRS SIMULTANEOUSLY:

27 Locomotives, 36 Passenger Cars, and 130 Freight Cars, besides Constructing and Repairing other Railway Materials, Mining Machinery, etc. Employees: 5,000 Japanese and Chinese.

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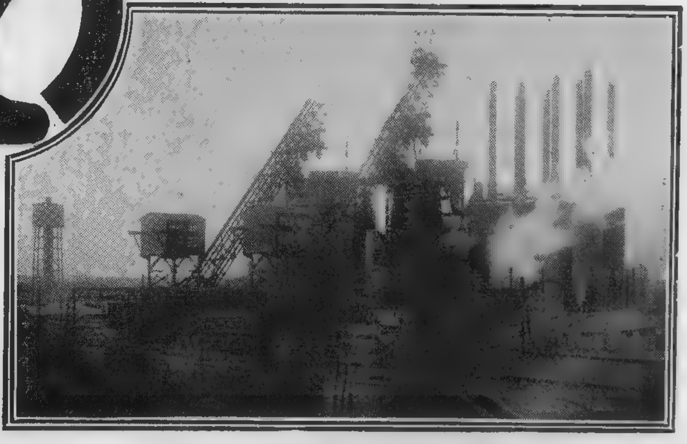
Togo Pit of the S.M.R. Fushun Collieries



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MINING DEPARTMENT,
South Manchuria Railway
Company, Dairen

ANZAN IRON & STEEL WORKS

New Enterprise Set Up Like Magic
Amidst the Wilderness of Manchuria.

TRACT OF LAND: about 4,000,000 tsubo.

BLAST FURNACE No. 1 (with a capacity for about 350 tons per day) Opened to service on April 29, 1919.

BLAST FURNACE No. 2 (with a capacity for about 350 tons per day) Made ready for service on February 24, 1920.

MEANS OF TRANSPORTATION in the plant: 24 miles of railway and 2.5 miles of electric tramway in operation, with three light locomotives and a number of slag-, coke, and ore-cars of from 8 to 24 tons.

A NEW TOWN SITE of 400,000 tsubo, with the necessary roads and water and sewage services, laid out and rented to lessees.

OFFICIALS AND EMPLOYEES: 2,300 Japanese and Chinese.

BUT THE TWAIN HAS MET AND BLENDED HERE

SOUTH MANCHURIA RAILWAY

MANCHURIA AND CHOSEN LINES

Circular and Overland Trips at Greatly Reduced Rates

TOURIST TRAVEL OFF THE BEATEN TRACK

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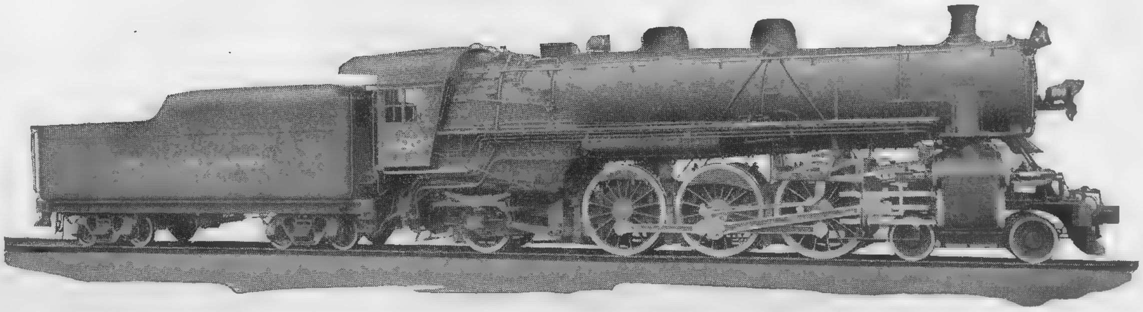
Head Office: DAIREN

Branch Offices: TOKYO, SEOUL, HARBIN, KIRIN, PEKING, SHANGHAI AND NEW YORK.

Telegraphic Address: MANTETSU or SMRCO. Codes: A.B.C. 5th & 6th Editions, A1 Lieber's, and Bentley's

THE THREE CYLINDER LOCOMOTIVE



THREE CYLINDER LOCOMOTIVE BUILT FOR THE ROCK ISLAND RAILWAY

Weight on Driving Wheels, 187,000 pounds; Weight of Engine, 301,000 pounds; Three Cylinders, 22½ × 28 inches; Diameter of Driving Wheels, 74 inches; Boiler Pressure, 190 pounds; Maximum Tractive Power, 46,400 pounds.

A more uniform turning movement permitting greater tractive power per pound of weight on drivers.

Reduction in piston thrust due to smaller size of piston used.

Reduction in reciprocating weight per individual cylinder with corresponding reduction in counterbalance and hammer blow on rail.

Increased and steadier draft due to six exhaust impulses instead of four.

Increased tonnage per pound of weight on drivers.

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AMERICAN LOCOMOTIVE SALES CORPORATION

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Telegraphic Addresses:

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Mitsui: Tokyo, Japan

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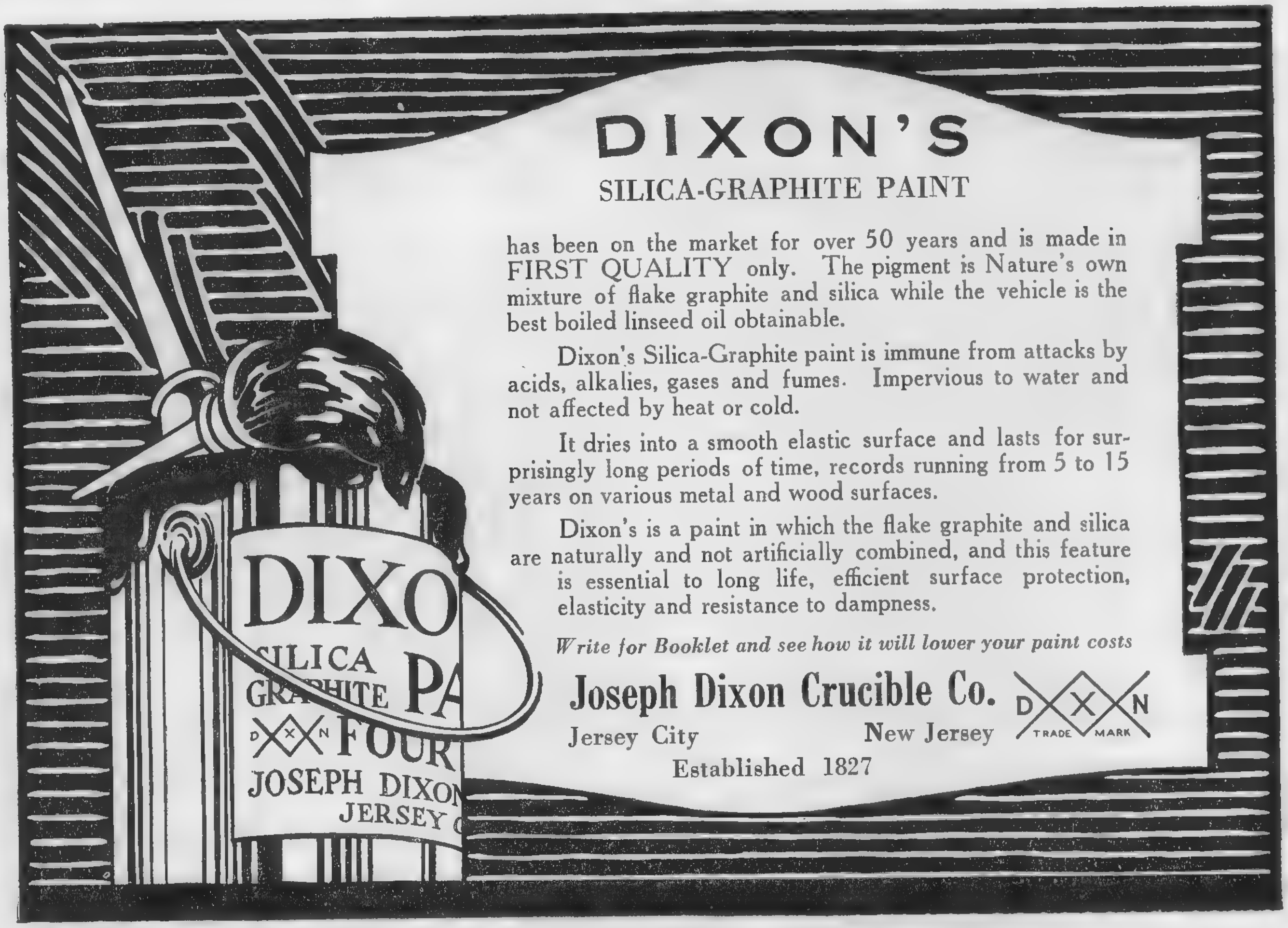

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SILICA-GRAPHITE PAINT

has been on the market for over 50 years and is made in FIRST QUALITY only. The pigment is Nature's own mixture of flake graphite and silica while the vehicle is the best boiled linseed oil obtainable.

Dixon's Silica-Graphite paint is immune from attacks by acids, alkalies, gases and fumes. Impervious to water and not affected by heat or cold.

It dries into a smooth elastic surface and lasts for surprisingly long periods of time, records running from 5 to 15 years on various metal and wood surfaces.

Dixon's is a paint in which the flake graphite and silica are naturally and not artificially combined, and this feature is essential to long life, efficient surface protection, elasticity and resistance to dampness.

Write for Booklet and see how it will lower your paint costs

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Established 1827

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Our line of brass valves has been designed to cover every requirement ordinarily met with in pipe lines.

We manufacture Brass Globe and Gate Valves designed for 100, 125, 150, 200, 250 and 300 lbs. working steam pressure. Higher pressures for hydraulic work.

All our brass valves are equipped with malleable-iron, non-heating wheels which not only add to their appearance but are non-breakable.

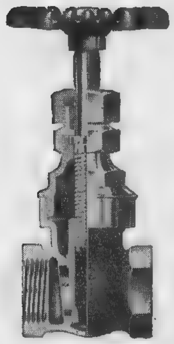

Fig. W 2471
FEDERAL
WEDGE GATE
125 Pounds
Steam Pressure

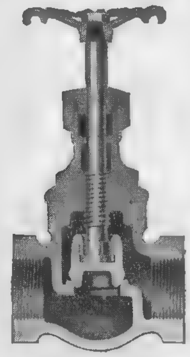

Fig. W 3121
GLOBE VALVE
250 Pounds
Steam Pressure

For Catalog, prices or information, address:
Walworth International Co., 29 Szechuen Road, Shanghai, China.

Walworth Manufacturing Co.
Boston, U.S.A.
Established 1842

Walworth International Co.
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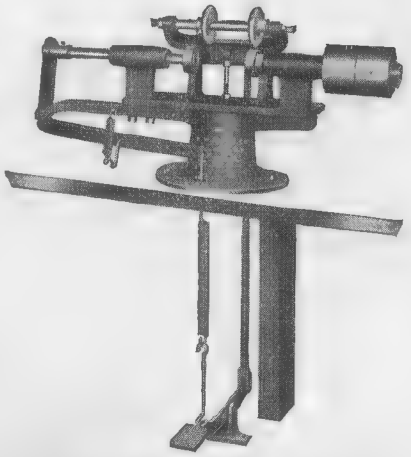
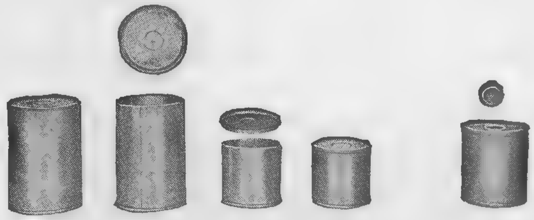
Manufacturers of 23,000 different items

Valves, Fittings, Tools for Steam, Water, Gas, Oil and Air

One of The Many Types of Tin Containers Made in Bliss Machinery



Bliss No. 1 Horizontal Double End Crimper. This machine will attach simultaneously the tops and bottoms to can bodies.



We build complete lines of machines for the manufacture of condensed and evaporated milk cans as illustrated above. Automatic machines for large plants and semi-automatic machines for plants of medium capacity.

The machine illustrated is one of several required for a daily production of 5,000 "Standard" condensed milk cans.

The knowledge gained in our 68 years' experience in building this type of machinery is incorporated right in the machines.

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1500 GOOD TOOLS

Thickness or Feeler Gauge No. 359 for determining thicknesses by half.thousandths from .0015 to .0615 inch.

Screw Pitch Gauge No. 135 with 22 pitches for V-threads

Thickness or Feeler Gauges: Goodell-Pratt offer eight different sizes of these gauges for determining thicknesses. The leaves of these tools are clearly marked and are warranted accurate.

Screw Pitch Gauges: Very useful tools for determining the number of threads to the inch of various screws and nuts. Made in all popular sizes—all leaves accurately milled and nicely polished.

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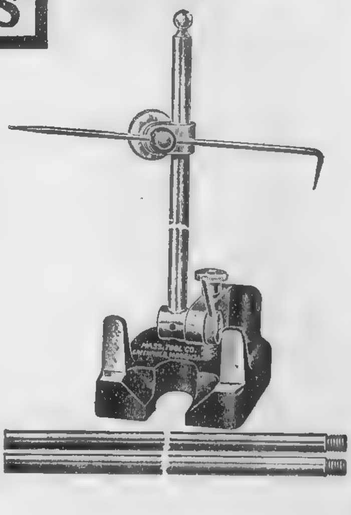
Free catalogue on request.
Export orders given especial packing and careful attention throughout.



Surface Gauge No. 57. Spindle has a movement of 180 degrees with a fine adjustment

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Tubular Steel Tramway & Electric Light Poles.
Ashford's Patent Tube Well Strainers.
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STEWARTS AND LLOYDS, LTD.

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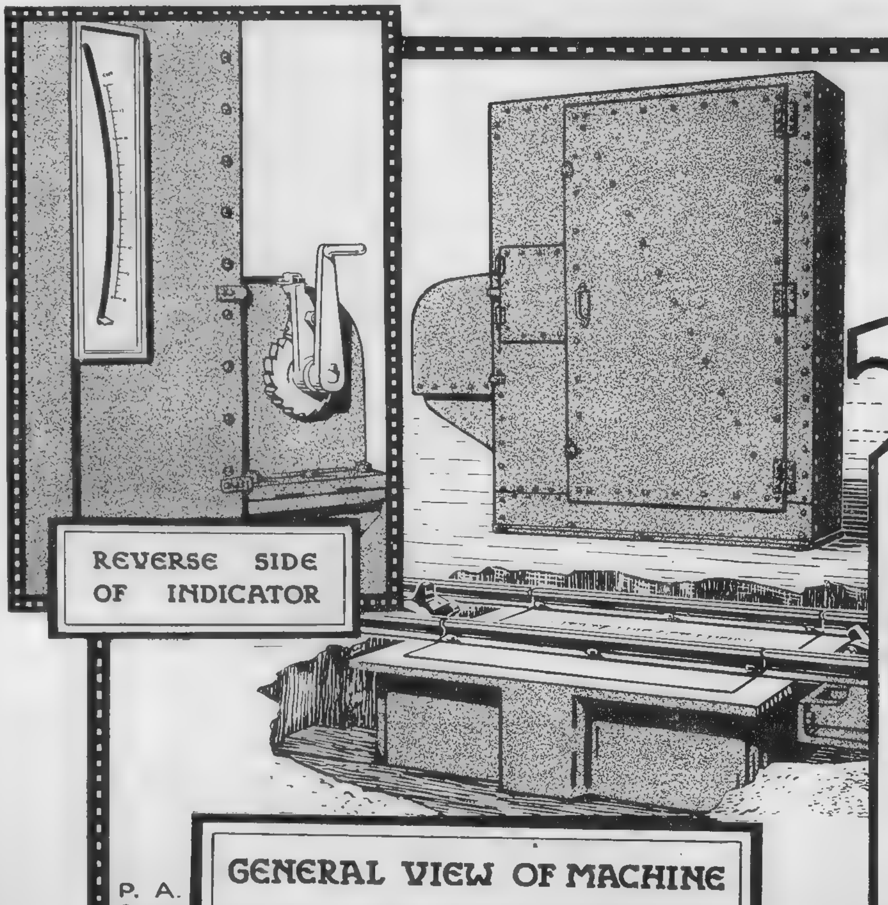

REVERSE SIDE OF INDICATOR

GENERAL VIEW OF MACHINE WITH AUTOMATIC INDICATOR

P. A. 230

FOOL-PROOF WEIGHING

POOLEY

FOOL PROOF COLLIERY WEIGHBRIDGE.
PATTERN No. 1082/1086.

SPECIALLY DESIGNED FOR COLLIERIES.

THIS MACHINE IS SO CONSTRUCTED THAT IT IS ABSOLUTELY IMPOSSIBLE TO WEIGH OR RECORD ANY LOAD TWICE.

FOR PRICE AND FULL PARTICULARS, APPLY TO
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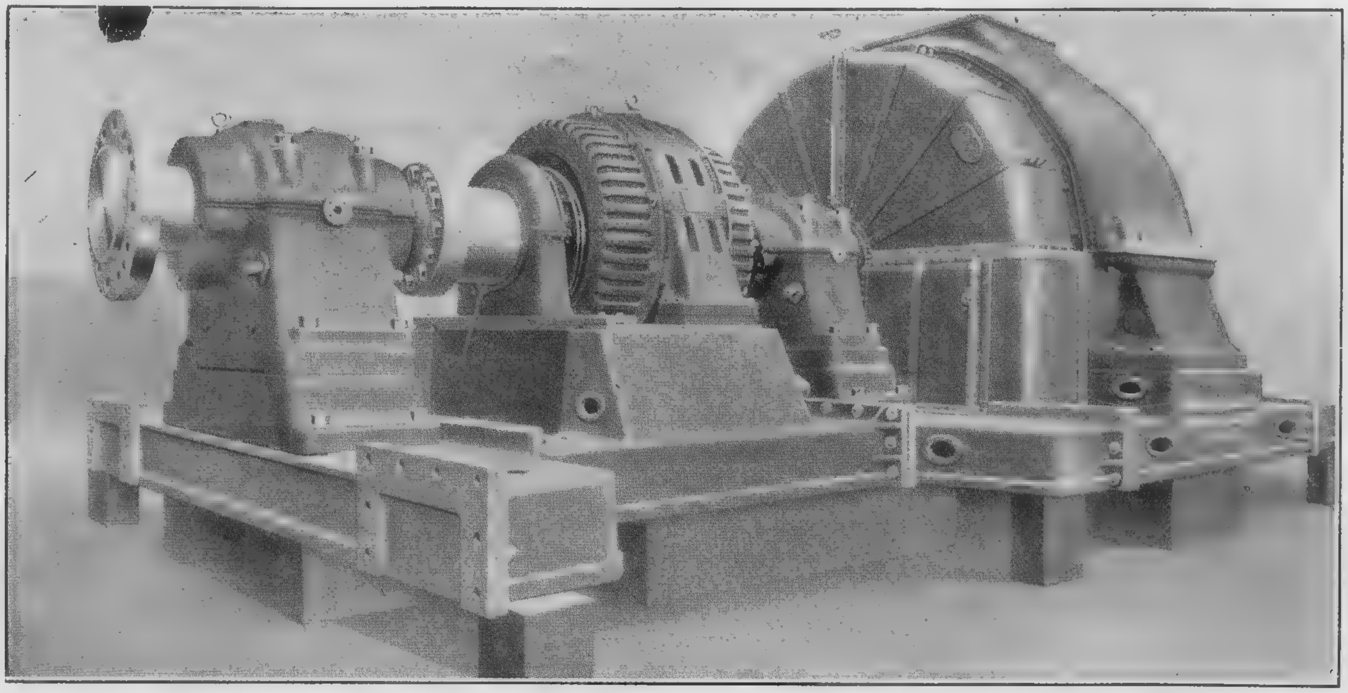

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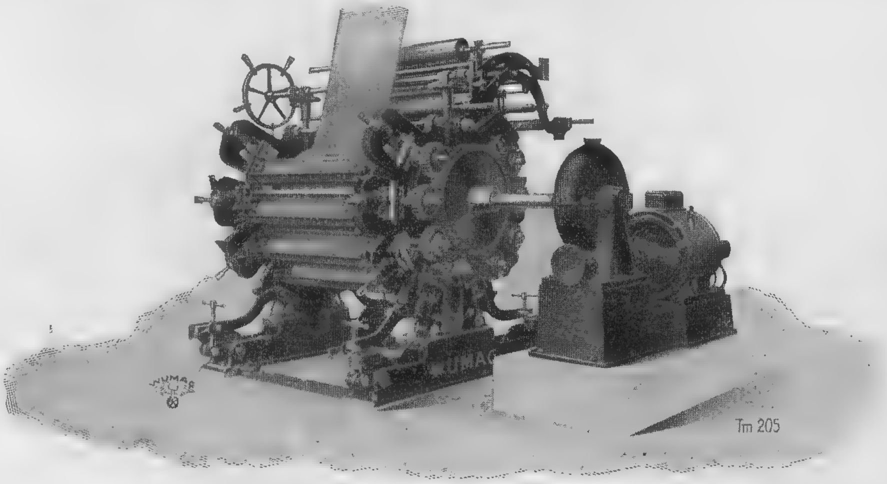

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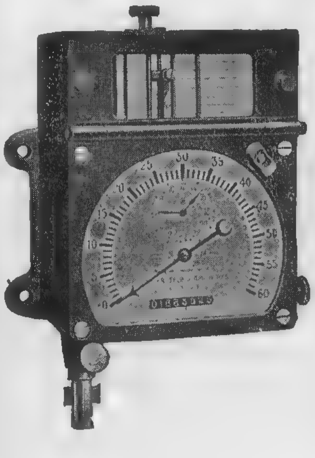

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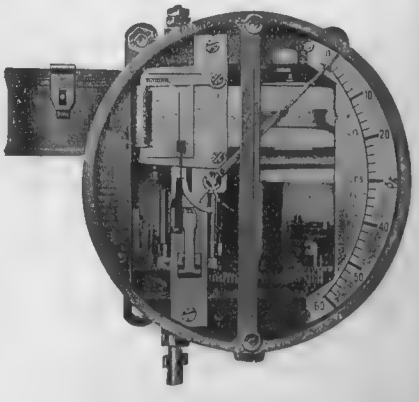

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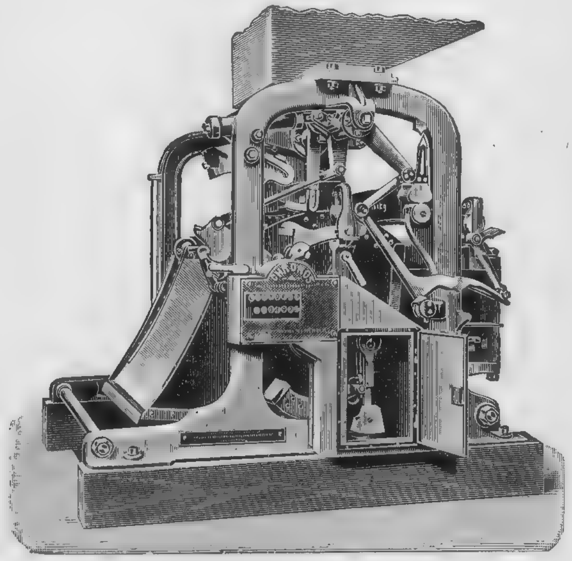

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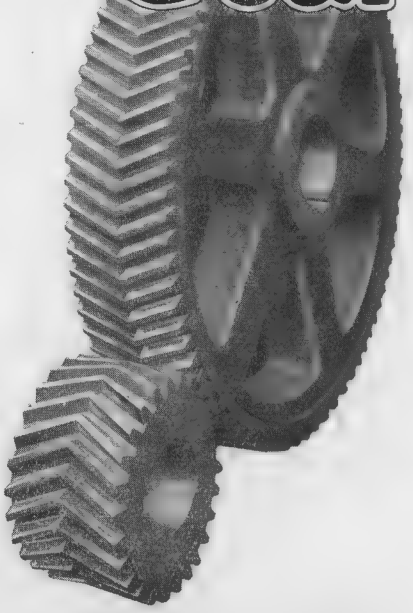

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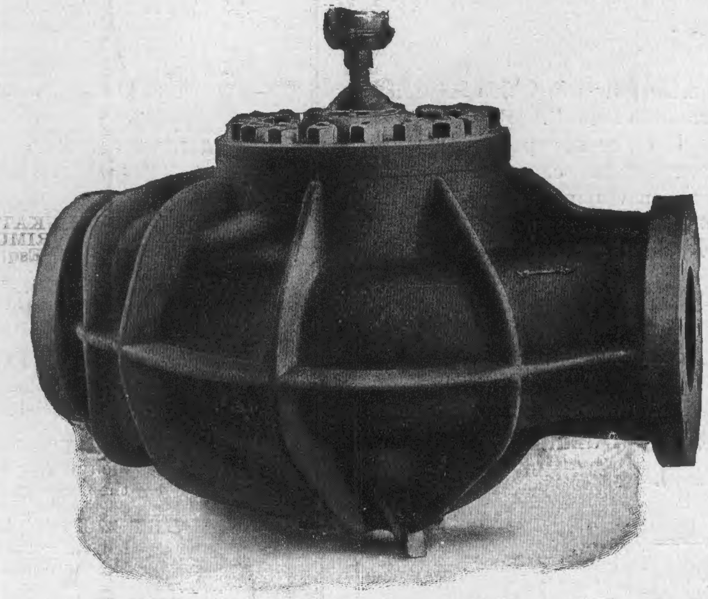

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